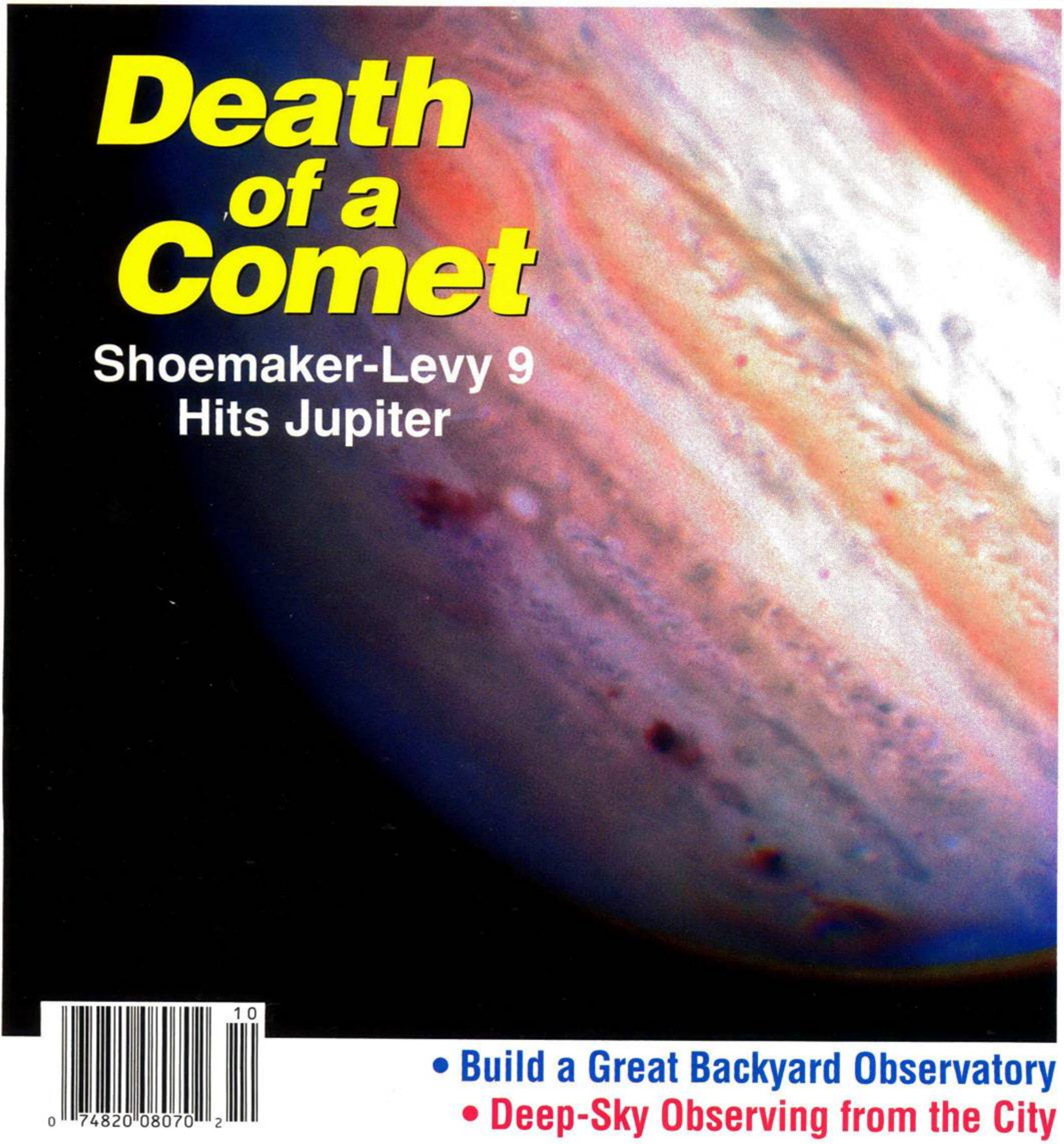
Magnetic Mysteries of the Moon

ASTRONOMY®

October 1994 U.S. $3.50
U.K. £1.95
Can. $4.50

Where Have All the Black Holes Gone?

ICD 08070



Death of a Comet

Shoemaker-Levy 9
Hits Jupiter

10
0 74820 08070 2

- Build a Great Backyard Observatory
- Deep-Sky Observing from the City

MEADE
12" LX200
10" LX200
8" LX200

Supplied complete per catalog specifications**:

8" LX200 Schmidt-Cassegrain	**$2495.**
10" LX200 Schmidt-Cassegrain	**$2895.**
12" LX200 Schmidt-Cassegrain	**$3995.**

Packing & shipping in 48 states: 8"—$105; 10"—$145; 12"—$215.

- **All prices shown are suggested USA mail-order retail prices, exclusive of sales taxes or credit card charges, if applicable.
- For dealer or catalog information see the **Meade Starfinder Reflecting Telescope** ad in this issue.

LX200
SCHMIDT-CASSEGRAINS

Now with *one arc-minute* pointing accuracy and 64,350-object onboard database as *standard-equipment!*

Meade 8", 10", and 12" LX200 models with standard-equipment High-Precision Pointing™ software now automatically GO TO any input RA and Dec, or to any object in the 64,350-object database, to a pointing precision within one arc-minute!

New Meade Version 3.30 software and high-resolution encoders, used in conjunction with the unique Meade SYNC command, now yield the most precise automatic slewing ever offered in a commercial telescope, an observatory-level of precision and *more than 5 times the precision obtainable with any competing computer-controlled telescope.* Data entry through the telescope's keypad hand controller may be made either from the onboard 64,350-object library database *(see description at right)* or by inputting the desired object's RA and Dec.

Such precise object-acquisition, selectable during either altazimuth or equatorial operation of the LX200, has numerous important implications for the serious observer:

HIGH PRECISION
HP
POINTING

LX200's with High-Precision Pointing have the HP logo-plate affixed to the telescope's drive base.

☐ Use the GO TO command to *find and center an object in the field of a 4mm eyepiece.*

☐ With other telescopes, acquiring even bright objects on the chip of a CCD imager is generally a chore at best, searching and slewing by trial-and-error until at last the object is positioned on the chip. The LX200's High-Precision Pointing places *every* object on *every* CCD chip *every* time.

☐ Suppose you wish to CCD-image a supernova in an 18th magnitude galaxy—a galaxy invisible *except* through the process of CCD imaging. With Meade High-Precision Pointing, the galaxy can be placed on the chip of every commercially-available CCD unit.

☐ Photographing or imaging faint objects such as the planet Pluto, or comets and asteroids near the photographic limit of the telescope, and plotting the motion of these objects night-to-night, now becomes practical, since the photograph or image may be taken *without the observer ever having seen the object visually,* but knowing that the LX200 will place the object precisely in the telescopic field.

All Meade LX200 models now include a 64,350-object onboard database as standard equipment.

Imagine having 64,350 celestial objects at the tip of your finger: 64,350 objects that you can actuate and center in the telescopic field just by entering and pressing GO TO on the hand controller. **More than 6 times the size of object libraries included with competing telescopes,** the Meade 64,350-object library includes an incredible array of phenomena—virtually a lifetime of deep-space study, even for the advanced observer:

12,921	galaxies from the Uppsala General Catalog; the complete UGC catalog.
7,840	objects from the New General Catalog; the complete NGC catalog.
5,386	objects from the Index Catalog; the complete IC catalog.
21,815	variable stars; the complete listing from the General Catalog of Variable Stars.
15,928	stars from the Smithsonian Astrophysical Observatory (SAO) catalog of stars brighter than 7th magnitude.
351	alignment stars for the LX200 telescope.
110	Messier objects; the complete listing.
8	major planets from Mercury to Pluto.
64,359	objects, total

SPECIFICATIONS: 8", 10", and 12" LX200's—Each complete telescope includes 8" or 10" (f/6.3 or f/10) or 12" f/10 Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, dual-axis 5.75" worm gears, and multi-function control panel display on the drive base; manual and electric slow-motion controls on both axes; keypad handheld controller with digital readout display, permanently programmable Smart Drive™, 9-speed drive controls on both axes (7-speed on 12"), High-Precision Pointing, and GO TO controller; 64,350-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC (for field operation from any 12v. auto cigarette lighter plug, use the Meade #1812 Electronic DC Adapter, a 4-oz. unit available optionally); 8 x 50mm viewfinder with crosshairs; 1.25" diagonal prism (8", 10") or 2" diagonal mirror with 1.25" adapter (12"); Series 4000 Super Plössl 26mm eyepiece; standard field tripod (8", 10") or giant field tripod (12"); foam-fitted carrying case; complete operating instructions.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
16542 Millikan Avenue, Irvine, Calif. 92714 ☐ (714) 756-2291
FAX: (714) 756-1450

© 1994

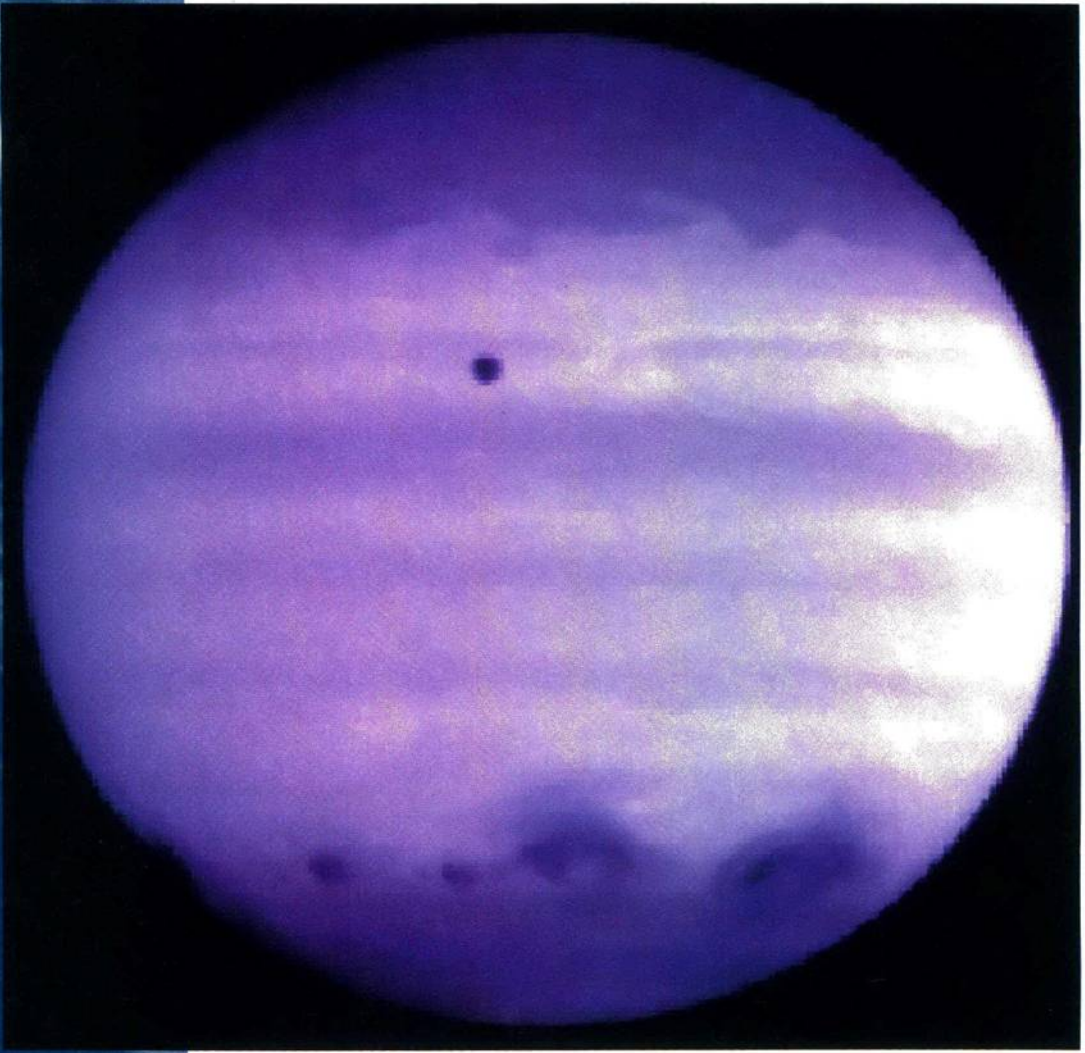
October 1994 Vol. 22, No. 10

ASTRONOMY®

L. Eduardo Vega

56

40



NASA/HST

68

Luke Dodd

NASA

28

A Swirl of Moondust

What's black and white and intensely magnetized? Scientists have yet to solve this riddle concerning a few enigmatic lunar features. By Bridget Mintz Testa.

36

Where Have All the Black Holes Gone?

They're everywhere, astronomers used to say. But no more. Despite extensive searches, astronomers have turned up only three promising stellar candidates. By Barry Parker.

40

Death of a Comet

Like volleys from a super-powered machine gun, the fragments of Comet Shoemaker-Levy 9 riddled Jupiter with explosive force. By David J. Eicher.

46

Sky Almanac

Binoculars and rich-field telescopes will provide stunning views of the Red Planet as it slides through the Beehive star cluster. By Deborah Byrd and Rick Shaffer.

56

What Is That Thing in Your Backyard?

ASTRONOMY's readers share their ideas and designs for building a great backyard observatory. By David Bruning.

62

Snatching Beauty from the Deep Sky

What's the best way to record detail in your favorite deep-sky objects? Shoot with super-sharp black and white film. By Martin C. Germano.

68

Bright Lights, Deep Sky

Just because urban light pollution floods your backyard, don't think distant galaxies, clusters, and nebulae are out of reach. By Michael Porcellino.

72

Under the Southern Sky

Eta Carinae, the Large Magellanic Cloud, the Coal Sack, and more. These are just some of the treats awaiting observers who tour the sky from "down under." By Jim Barclay.

DEPARTMENTS

6 Behind the Scenes
- 1994's Great Comet Crash

6 Letters

12 Viewpoints
- Eighty South: An Antarctic Odyssey

18 AstroNews
- Broken Promise
- Russians Say Mars Can Wait
- The Biggest and Best Model of the Universe
- Weighing Omega Centauri
- Clementine Maps Moon's Topography
- Stellar Mystery Solved
- Dusty Birth Announcement
- Dust Bubbles Around AG Carinae
- SERENDIP Hopes for Lively Reruns

22 Amateur News
- Rendezvous at Riverside

81 Reader Reports
- Golden Eclipse Memories

88 New Products
- 16-Inch Schmidt-Cassegrain Telescope
- ST-5 CCD Imaging Camera
- Weatherproof Binoculars

92 AstroBytes
- Star Guide

98 Astronomy Books
- Treading the Telescope Minefield

100 Meetings and Events

106 Advertiser Index

106 Readings and Credits

COVER

DARK SPOTS MARK THE SITES where fragments of Shoemaker-Levy 9 smashed into Jupiter and blew material high into the planet's stratosphere. To see more, turn to page 40. NASA/HST image.

BEHIND THE SCENES

1994's Great Comet Crash

What a week!

(Quick question: How many of the impact sites did *you* personally see?) For me, Comet Shoemaker-Levy 9 moved out of the artificial realm of TV and became real on Monday evening, July 18. A friend and I were using his 6-inch refractor to check out a Moon map. We finished at sunset, but the sky was too bright to show Jupiter. The telescope's mount was an altazimuth, which ruled out using setting circles to locate the planet. So we went inside, leaving the scope to the mosquitos.

Twenty minutes later the sky had darkened and Jupiter was easy to find, although by now a cloud deck was drifting in from the west. Hurredly we located Jupiter in the eyepiece at 200x — and there was a spot, black as night and bigger than I expected. It was where fragment C had struck, and it was still prominent more than two Jupiter-days after impact.

Flash of fragment K.

P. McGregor and M. Allen, ANU

The hair on the back of my neck prickled. Why? I think it's because we backyard astronomers get used to seeing celestial objects that always look the same or change only minutely. So when something this drastic happens, it's downright eerie. How long the impact sites will remain visible is unclear as I write. But for at least a while, the telescopic Jupiter looks immediately different from what we've always known.

The events of the Great Comet Crash were an astounding and delightful surprise (see page 40). But why were predictions so underwhelming? I suspect a number of reasons. First, remembering the unspectacular apparitions of Kohoutek in '74 and Halley in '86, astronomers were careful not to oversell it this time. Second, no one knew exactly how big the fragments were. And last, the first-ever nature of the event meant that no one really *could* make very accurate predictions anyhow — so better safe than sorry. As a result, many planetary scientists were caught by surprise along with the rest of us.

Well, we saw what happened to Jupiter. But it's also reasonable to ask what kind of impact Carolyn and Gene and David's comet will have on backyard astronomy. Time alone will tell, but I bet at least some of the crowds of curious people who temporarily took up residence in our hobby will remain, drawn by the drama of the universe.

Now is a perfect time for each of us with a telescope and a boundless fascination with the heavens to help share this wonder as far and wide as we can.

Sincerely,

Robert Burnham
Editor

LETTERS

Did the Right Stuff Go Wrong?

The July issue of ASTRONOMY was a real treat. The 25th anniversary of the Apollo Moon landing does not mark a happy time in the minds of many Americans, however. The cultural distance between 1969 and 1994 is probably greater than the distance between Earth and the Moon.

For one brief, shining moment we as a society — for all of its imperfections — had the "right stuff" to send its representatives to the Moon. Whatever the reason or reasons, we simply don't have the right stuff today. Perhaps it was the aftermath of the assassination of John Kennedy, the Vietnam War, or Watergate. The "fire on the Moon," like the fire in our cultural hearts, has gone out. Today, we seem to want something more like "space exploration lite." Not too demanding, not too expensive, and not too time consuming.

Will we go back to the Moon? Others may; America will not. I believe Ben Bova or Isaac Asimov suggested that a unique, short window in time existed when Americans could launch a journey to the Moon. We had the national wealth, the technology, and the will.

As the United States has evolved, we have lost these qualities. We seem to be preoccupied with tabloid television now. NASA, of course, reflects these downward trends. Lacking leadership from the White House or Congress, the space agency amuses itself with science play in the cargo bay of the shuttle.

Apollo was a hell of an achievement. Perhaps it was enough that before our national spirit flickered and died we accomplished that one magnificent feat.
— Milt Hays, Jr., Jacksonville, Florida

Your Eye: Key Ingredient

"Test Your Scope's Optics" in the July issue told how to examine the image in a telescope for optical flaws. It also said that sometimes flawed images come

(continued on page 12)

ASTRONOMY®

Robert Burnham Editor
Rhoda Sherwood Managing Editor
David J. Eicher Associate Editor
David H. Bruning Associate Editor
John Shibley Associate Editor
Richard Talcott Assistant Editor
Tracy Staedter Editorial Assistant
Julie Sherwin Editorial Secretary

Thomas L. Hunt Art Director
Gary Kachar Graphic Designer

U.S. and International Newsstand Distribution
I.C.D., The Hearst Corp., New York, NY 10019

Walter J. Mundschau President
Russell G. Larson Publisher
Jim Marsala Managing Art Director
Karin O. Frederickson Production Director

Daniel R. Lance Vice President, Sales & Marketing
Kimberly A. Bennett Advertising Sales Manager
Debbi A. Simon Advertising Sales Representative
Tracy Lando Advertising Services Representative
Advertising Department (800) 558-1544
Joel Park The Environmental Magazine Network, (908) 671-4036

Canadian Newsstand Distribution
Telemedia Dist., Toronto, Ontario M4S 3B3

ASTRONOMY is published monthly by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Editorial phone: (414) 796-8776; advertising: (800) 558-1544; customer service: (800) 446-5489; subscriptions: (800) 533-6644 7 days a week, 24 hours a day; fax (414) 796-0126. Copyright © 1994 Kalmbach Publishing Co., all rights reserved. Material in this publication may not be reproduced in any form without permission. Second-class postage paid at Waukesha, WI, and additional mailing offices. Allow 6 to 8 weeks for new subscriptions and address changes. Subscription price: 1 year $27. Canadian and foreign: 1 year $38, GST (#R122713209) included; please remit in U.S. funds. Not responsible for unsolicited materials. POSTMASTER: Send address changes to Astronomy, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Canadian second-class postal permit no. 545775. Printed in the U.S.A.

The Audit Burea

PICTOR™ SERIES CCD AUTOGUIDER/IMAGERS

MEADE PICTOR
CCD AUTOGUIDER
Meade
OFF-AXIS GUIDER

Pictor 201 Autoguider: $395.*

MEADE
MODEL 416
PICTOR
CCD IMAGING SYSTEM
MEADE
PICTOR

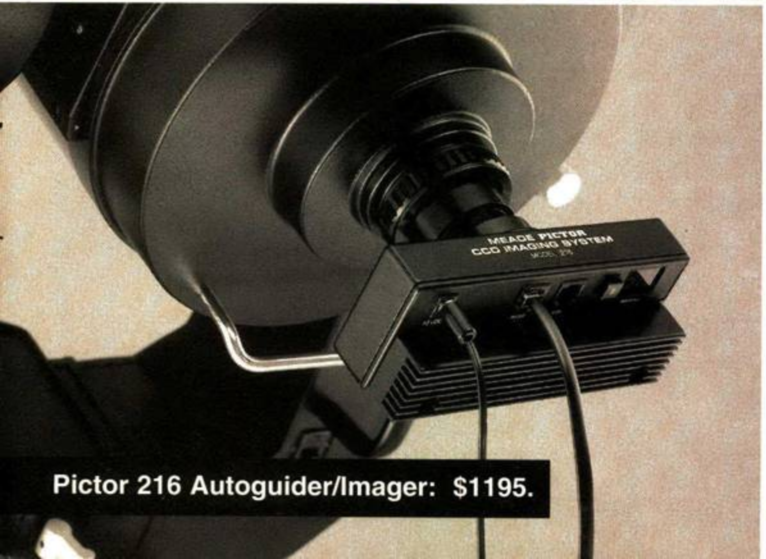
Pictor 416 Autoguider/Imager: $2495.

MEADE PICTOR
CCD IMAGING SYSTEM

Pictor 208 Autoguider/Imager: $795.

MEADE
PICTOR
CCD IMAGING SYSTEM
MEADE
PICTOR

Pictor 1616 Autoguider/Imager: $6995.


MEADE PICTOR
CCD IMAGING SYSTEM

Pictor 216 Autoguider/Imager: $1195.

For the beginner, or for the most advanced observer, the *real* CCD revolution is here. There's a Meade® CCD system to fit your budget and your imaging requirements.

To obtain your copy of the all-new Meade 76-page 1994-95 General Catalog ($3.00 ppd.), see your authorized Meade Advanced Products Dealer or write directly to Meade Instruments.

*Plus packing and shipping; prices shown are suggested U.S.A. mail-order prices, not including any applicable sales taxes.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
16542 Millikan Avenue, Irvine, Calif. 92714
(714) 756-2291 ☐ FAX: (714) 756-1450

© 1994

STARFINDER™ DOBSONIANS

Now you can buy a Dobsonian telescope with quality Meade® optics and components—at a fraction of the price you'd expect to pay.

And, extended through September 30, 1994, receive a $125 Accessory Package for only $29.95!

MEADE
STARFINDER
MEADE

10" f/4.5
$565.

12.5" f/4.8
$765.

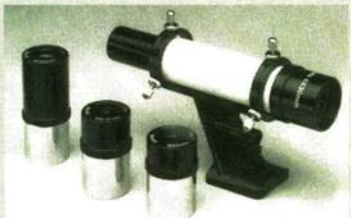
8" f/6
$395.

Shown with optional #637 6 x 30mm or #545 8 x 50mm Viewfinders

6" f/8
$295.

SPECIAL ACCESSORY OFFER!

Through September 30, 1994, at the time you order any Starfinder 6", 8" 10", 12.5", or 16" Dobsonian Telescope, you can buy **two additional Meade multi-coated Modified Achromatic MA9mm and 12mm eyepieces *and* the Meade #637 6 x 30mm coated achromatic viewfinder for a *total* of only $29.95! Purchased separately, the 2 additional eyepieces and viewfinder sell for $125.85!** *(Shown in photo: MA9mm, MA12mm, and standard-equipment MA25mm eyepieces, with #637 6 x 30mm viewfinder.)*



Starfinder Dobsonian 16

MEADE
STARFINDER
MEADE

16" f/4.5
$1195.

See the Meade General Catalog for details.

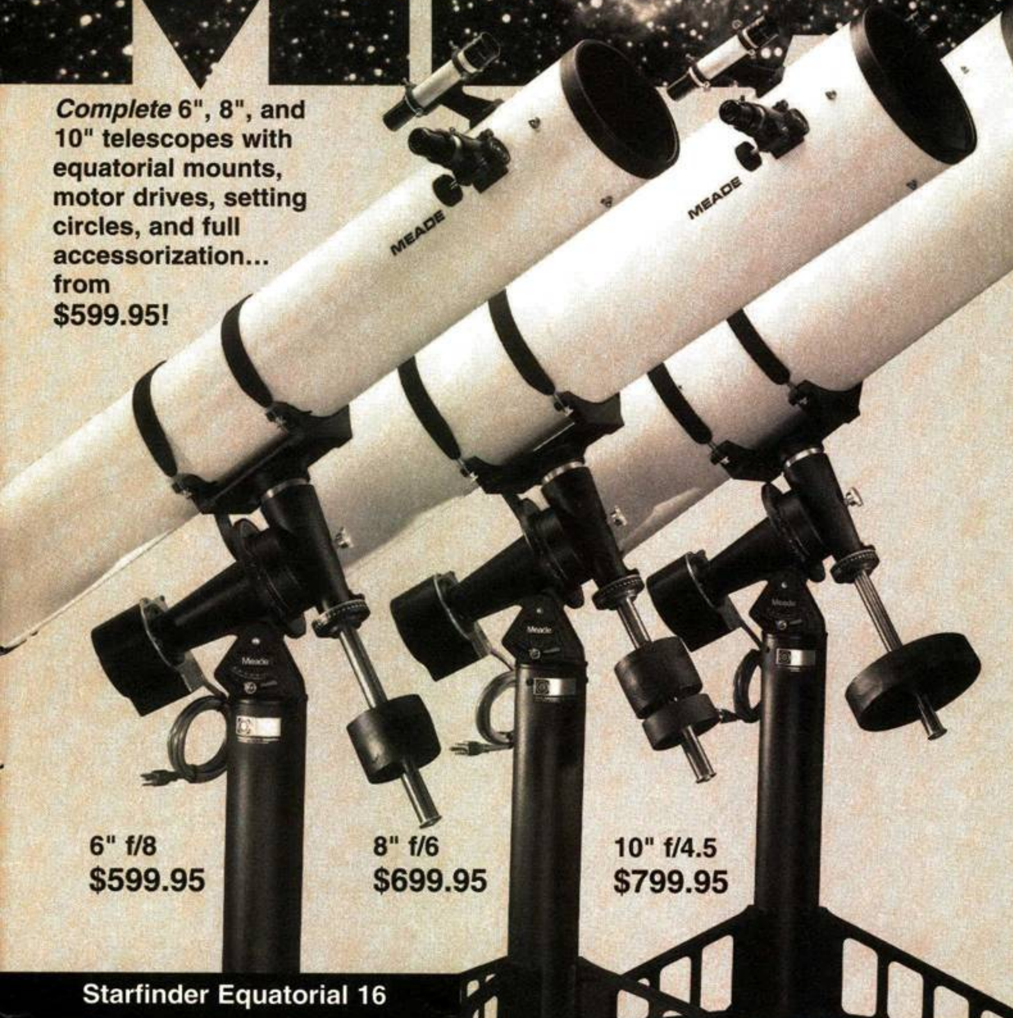
Includes giant #682 focuser; shown with optional 8 x 50mm viewfinder.

Compare Meade Starfinders *feature-for-feature* with other similarly priced Dobsonians!

- **Primary and Secondary Mirrors of Low-Expansion Pyrex® glass!** Unlike the plate-glass optics of other Dobsonians that can become thermally unstable (especially in larger apertures), Meade Dobsonians include the *exact same* professional-quality Grade-A, fine-annealed Pyrex® optical systems used on Meade Starfinder Equatorial Reflectors. Optics that meet the theoretical limits of resolution for their apertures.
- **Precision Rack-and-Pinion Focuser!** An industry-standard full-size rack-and-pinion system with 2.6" of focus travel.
- **Fully-Adjustable 4-vane Secondary Mirror Systems!** *Rigid 4-vane systems* that permit precision alignment of the secondary mirror to the primary mirror.
- **Rigid, Durable, Beautiful Dobsonian Mountings!** Mountings that provide extremely smooth motions of the telescope in both altitude and azimuth. Both telescope axes ride on zero-backlash Teflon/Nylon bearings, facilitating the location and tracking of celestial objects anywhere in the sky. Each mount is manufactured of cabinet-quality materials and designed for a lifetime of use. Handles are provided for easy portability.
- **Optical Tubes:** Starfinder Dobsonians include the same strong, spiral-wound optical tubes used on Starfinder Equatorials *(facing page).* All telescopes include a multi-coated MA25mm eyepiece as standard equipment. Each tube is factory pre-drilled for the optional 6 x 30mm or 8 x 50mm viewfinder.
- **Performance!** A Meade Starfinder Dobsonian or Equatorial Telescope opens up the skies to an extremely wide range of serious visual observing: all 110 Messier objects, thousands of NGC objects–nebulae, galaxies, star clusters, in all their variations of form, color, and extent, as well as the Moon and planets in stunning, high-resolution detail. Starfinder Dobsonians are telescopes for visual observing; motor-driven Starfinder Equatorials may be used, in addition, for lunar and planetary photography and even for limited deep-space astrophotography.
- **Packing and UPS Shipping Charges:** to any address in the 48 states: 6"–$39; 8"–$49; 10"–$69; 12.5"–$79. 16"–$45 packing, shipped truck freight collect.
- **To Order:** Contact one of the authorized mail-order dealers on the facing page.

STARFINDER™ EQUATORIALS

Complete 6", 8", and 10" telescopes with equatorial mounts, motor drives, setting circles, and full accessorization... from $599.95!

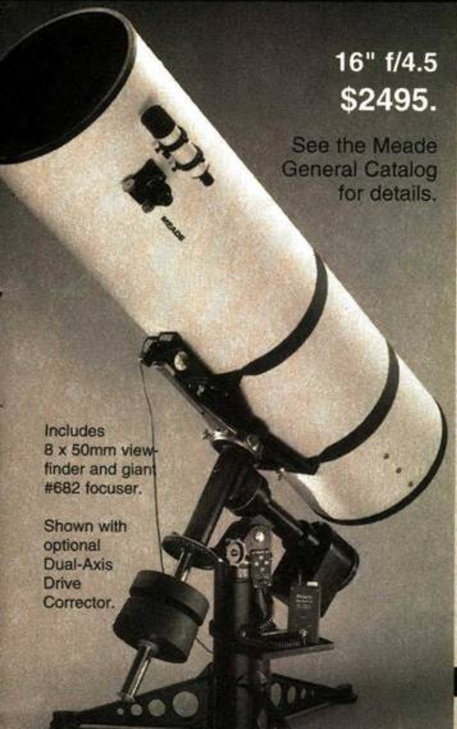


6" f/8
$599.95

8" f/6
$699.95

10" f/4.5
$799.95

Starfinder Equatorial 16



16" f/4.5
$2495.

See the Meade General Catalog for details.

Includes 8 x 50mm viewfinder and giant #682 focuser.

Shown with optional Dual-Axis Drive Corrector.

Standard equipment on 6", 8", and 10" models includes:

- **Superb Optical System:** Includes hand-figured parabolic primary mirror that meets the theoretical limit of resolution for its aperture, with matching elliptical flat secondary mirror. Both mirrors multi-coated and made of low-expansion, Grade A, fine-annealed Pyrex® glass.
- **Precision Equatorial Mount:** Manufactured of machined aluminum to tolerances of .001" or better, with 4"-dia. pier and die-cast tripod legs, for rock-solid support of the optical tube. The telescope moves effortlessly from object-to-object on precision bearing surfaces. Polar and declination shafts are 1" solid steel. Setting circles on both axes facilitate the location of faint objects directly from their catalogued coordinates.
- **Electric Motor Drive** (115v/60Hz) with 6 ft power cord: permits **fully automatic** tracking of celestial objects; plugs into any standard outlet.
- **Standard Accessories and Components:** Precision Rack-and-Pinion Focuser (1.25") with full 2.6" travel; coated achromatic #637 6 x 30mm Viewfinder with crosshair eyepiece and 7° field; multi-coated MA25mm (1.25") eyepiece, threaded for filters; strong, durable, spiral-wound optical tube with attractive white finish.
- **Optional Accessories:** See the Meade accessories ad in this issue. Additional systems, including #55 Manual Declination Control, #43 Drive Corrector, and #47M Dual-Axis Drive Corrector, are described in the Meade General Catalog.

SPECIAL ACCESSORY OFFER! Through September 30, 1994, at the time you order any Starfinder 6", 8", 10", or 16" Equatorial Telescope, you can buy **two additional Meade multi-coated Modified Achromatic MA9mm and 12mm eyepieces for a *total* of only $19.95! Purchased separately, the two additional eyepieces sell for $75.90.** *(Shown in photo: MA9mm, MA12mm, and standard-equipment MA25mm eyepieces.)*

- **Packing and UPS Shipping Charges:** to any address in the 48 states: 6"–$65; 8"–$75; 10"–$90. 16"–$55 packing, shipped truck freight collect.
- All prices shown are suggested USA mail-order retail prices, not including any applicable sales taxes.
- **All-new 1994-95 Meade General Catalog**–$3.00 postpaid–is available from any authorized Meade dealer or directly from Meade Instruments.
- For further information call Meade Instruments at 714-756-2291 or contact one of these authorized mail-order dealers:

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

CALIFORNIA TELESCOPE COMPANY, Burbank, CA.
Orders: 800-843-4780; Info.: 818-505-8424.

CITY CAMERA, Dearborn, MI.
Orders: 800-359-5085; Info.: 313-846-3922.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 510-447-9570.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders: 800-621-2248; Illinois & Info.: 312-332-2000.

Canada:
KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

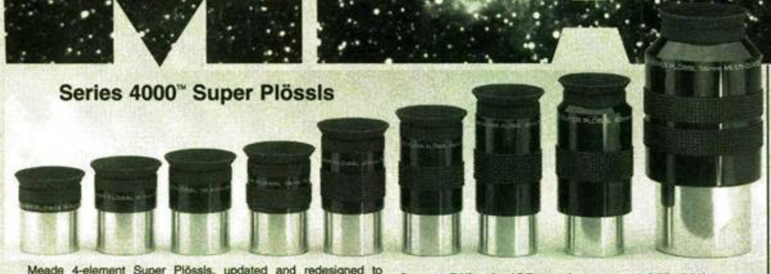
ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
16542 Millikan Avenue, Irvine, Calif. 92714 □ (714) 756-2291
FAX: (714) 756-1450

© 1994

MEADE

EYEPIECES AND ACCESSORIES

Series 4000™ Super Plössls



Meade 4-element Super Plössls, updated and redesigned to utilize the latest in optical glass-types for 1994, are the finest general-purpose eyepieces available. For observing hairline lunar and planetary detail, splitting close doubles, or for deep-space; guaranteed to deliver more contrast and image sharpness than any other brand. Rubber eyeguards fold down for eyeglass wearers–a feature not available on competing brands. Multi-coated. All focal lengths through 32mm are parfocal.

Super Plössls (SP; 4-elements; 1.25"; 52°):

6.4, 9.7, 12.4, 15, 20, 26mm each: **$87.95** (3.29)

32mm (52°); **40mm** (44°) each: **109.95** (3.79)

56mm (52°; 2") **229.95** (5.48)

Series 4000™ f/6.3 Focal Reducer/ Field Flattener

Manufactured to exclusive Meade optical designs; threads on to any Meade or Celestron Schmidt-Cassegrain rear cell and converts f/10 scopes to f/6.3 (or f/6.3 SCT's to f/4), while significantly flattening the field. Use with SCT visual or photo accessories. Actual visual field is increased by 56%, for fine wide-field views of star fields and nebulae. In astrophotography, reduces exposure times by about 50%, while producing an actual field diameter of 1.5" at the film plane. A tremendous aid with CCD Imagers in reducing image size for locating and centering images on CCD chips. 4-element optics; multi-coated; 41mm clear aperture.

$129.95 (3.60)

Series 4000™ Super Wide Angle

For exquisite wide-angle images at low-to-medium powers, ideal for star fields, galaxies, and other deep-space phenomena. SWA 13.8, 18, and 24.5mm are superb complements to the #140 Barlow.

Super Wide Angle (SWA; 6-elements; 1.25"; 67°)–**13.8mm: $159.95** (3.49); **18mm: 169.95** (3.69); **24.5mm: 199.95** (3.89); **32mm** (2"): **279.95** (4.78); **40mm** (2"): **339.95** (5.48)

Series 4000™ Ultra Wide Angle

The ultimate eyepieces; extreme image sharpness over an amazing 84° field.

Ultra Wide Angle (UWA; 8-elements; 1.25"; 84°)–**4.7mm: $179.95** (3.29); **6.7mm: 219.95** (3.29); **8.8mm** (1.25"/2"): **269.95** (4.78); **14mm** (1.25"/2"): **329.95** (5.48)

Series 4000™ #140 2x Apochromatic Barlow Lens

The most advanced Barlow Lens available for commercial telescopes; includes 3-element, air-spaced optics, multi-coated. Unmatched in image resolution, contrast and color correction. Accepts 1.25" eyepieces. Lens dia. 28mm; clear aperture 26mm.

$79.95 (3.29)

SALE! Meade®

Schmidt-Cassegrain Accessories

Through September 30, 1994, buy Meade premium-quality Schmidt-Cassegrain accessories at special sale prices and save up to 16%!

Series 4000 f/6.3 Focal Reducer/Field Flattener: Regular $129.95; Sale Price $114.95. Save 11%.

Series 4000 Nebular Filters: #911B — Regular $99.95; Sale Price $89.95. Save 10%. #911N — Regular $119.95; Sale Price $99.95. Save 16%.

T-Adapter for SCT: Regular $26.95; Sale Price $22.95. Save 15%.

Basic Tele-Extender for SCT: Regular $29.95; Sale Price $26.95. Save 10%.

Variable Tele-Extender for SCT: Regular $39.95; Sale Price $35.95. Save 10%.

#929 2" Diagonal Mirror for SCT: Regular $99.95; Sale Price $89.95. Save 10%.

Series 4000 Super Plössl 56mm Eyepiece (2"): Buy one eyepiece at the regular price of $229.95 and receive the #929 2" Diagonal Mirror FREE.

Series 3000 Plössl 40mm Eyepiece (1.25"): Regular $79.95; Sale Price $69.95. Save 12%.

All prices plus shipping, as noted in product descriptions. This offer is valid between June 20 and September 30, 1994, at participating Meade dealers and is subject to product availability.

Series 3000™ Plössls

The very latest in eyepieces from Meade optical designers, new Meade Series 3000 Plössls yield the finest image corrections obtainable from the classical 4-element Plössl design. Available in a wide range of focal lengths from 5mm through 25mm. All five eyepieces are parfocal, so that, at most, only slight refocusing of the image is necessary from eyepiece to eyepiece. Unlike competing moderately-priced Plössls, Meade Series 3000's are **multi-coated** for maximum light transmission and image contrast. Chrome-plated brass barrels are threaded for standard filters. Manufactured exclusively for Meade Instruments by one of Japan's leading lensmakers, Series 3000 Plössls produce excellent results on reflectors, refractors, and Schmidt-Cassegrains of any focal ratio.

Series 3000 Plössls (4-elements; 1.25"; 50°)

5, 6.7, 9.5, 16, 25mm each: **$57.95** (3.45) **Any 2: $52.95** each; **Any 3: $48.95** each; **Any 4 or 5: $46.95** each.

Series 3000™ Plössl 40mm

A perfect complement to the Series 3000 Plössls at left, this all-new Plössl 40mm produces spectacular low-power, wide-field results with any telescope. Includes classical 4-element Plössl optics, multi-coated. Barrel dia. 1.25"; threaded for filters. Apparent field: 44°.

$79.95 (3.79)

Series 4000 Photo-Visual Color Filters (1.25")—Made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Thread into the barrels of virtually all 1.25" eyepieces sold today. Fully coated.

#8 Lt. Yellow; #11 Yellow Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue

each **$14.95** (2.29)

Moon Filter #ND96–Reduces brightness by 87%.	**16.95**	(2.29)
Set #1–4 filters: #12, #23A, #58, #80A	**54.95**	(2.98)
Set #2–4 filters: #11, #25A, #47, #82A	**54.95**	(2.98)
Set #3–4 filters: #8, #21, #38A, #56	**54.95**	(2.98)
Sets #1 & #2–8 filters	**99.95**	(3.45)
Sets #1, #2, & #3–12 filters	**144.95**	(3.79)

#911B
#910B
#908B
#911N
#910N
#908N

Series 4000 Nebular Filters—Premium multi-layer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high-contrast observing of faint nebulae.

#908B–Threads into 1.25" eyepieces, 26mm dia.	**79.95**	(2.98)
#910B–Threads into 2" eyepieces, 44mm dia.	**119.95**	(3.29)
#911B–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**99.95**	(3.29)
#908N–Threads into 1.25" eyepieces, 26mm dia.	**89.95**	(2.98)
#910N–Threads into 2" eyepieces, 44mm dia.	**129.95**	(3.29)
#911N–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**119.95**	(3.29)

World's Most Advanced Illuminated Reticle Eyepiece

Series 4000 Plössl 9mm, with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. **Internal batteries included.** Multi-coated optics. Bullseye reticle. 1.25"

$149.95 (3.45)

Series 4000 Plössl 9mm—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator.

$129.95 (3.45)

MA 12mm Illuminated Reticle Eyepiece

Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle. Wireless red LED illuminator and variable brightness control. **Batteries included.**

$99.95 (3.45)

MA 12mm—Same as above but with cord and plug for Meade telescopes with power panels, in place of wireless illuminator.

$79.95 (3.45)

2" Diagonal Mirror

#929: Permits use of wide-field 2" oculars. Threads on to rear cell of Meade and Celestron SCT's. Includes multi-coated precision optical flat made at the Meade factory; with 1.25" eyepiece adapter. **$99.95** (3.79)

Camera Adapters (1.25" & .965")

Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, threaded for filters. Use with T-mount, available separately.

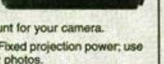
.965": $27.95 (2.98) **1.25": $29.95** (2.98)

Variable-Projection Camera Adapter (1.25")

Machined sliding cell allows variable projection power in eyepiece-projection photography; permits precise selection of correct photo power in lunar and planetary photography; threaded for filters. Use with T-mount for your camera.

$39.95 (2.98)

Tele-Extenders



For Eyepiece-Projection photography with any Meade or Celestron SCT. Threads on to any eyepiece-holder. Use with T-mount for your camera.

Basic Tele-Extender: *(above)* Fixed projection power; use with eyepiece for lunar and planetary photos.

$29.95 (2.98)

Variable Tele-Extender: Sliding cell, with lock, permits wide range of projection magnifications with the same eyepiece.

$39.95 (2.98)

T-Adapters for SCT's

For Prime Focus photography with any Meade or Celestron SCT. Use with T-Mount for your 35mm camera.

$26.95 (2.98)

2x Telenegative Barlow (1.25")

#122: Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (26mm clear aperture). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. Multi-coated. 1.25"

$47.95 (3.45)

2x-3x Variable Barlow (1.25")

#127: Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25"

$59.95 (3.45)

2x Short-Focus Barlow (1.25")

#126: Only 2.5" long, the #126 works well with any telescope accepting 1.25" eyepieces, even those with limited focus range. Maintains the high image quality of the #122, above. Insert the #126 into star diagonal for 2x or insert star diagonal into #126 for 3x. 26mm clear aperture. Multi-coated.

$47.95 (3.45)

Modified Achromatic Eyepieces

An improvement on the traditional Kellner design, these 3-element Modified Achromatic eyepieces give sharp, faithful, well-corrected images of the moon, planets, and deep-space at an economical price. Multi-coated; threaded for filters; 1.25" barrel diameter. Apparent field: 40°. **MA 9, 12, 25, 40mm.**

each: **$37.95** (2.98)

HOW TO ORDER

- Prices shown are suggested USA mail-order retail prices and do not include any applicable sales taxes.

- Suggested shipping and handling charges to the 48 states by UPS or US Mail shown in ( ) next to each price.

- Meade accessories may be ordered from any Meade Advanced Products Dealer. **The following national mail-order dealers carry all Meade accessories in-stock for immediate shipment:**

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

CALIFORNIA TELESCOPE CO., Burbank, CA.
Orders: 800-843-4780; Info.: 818-505-8424.

CITY CAMERA, Dearborn, MI.
Orders: 800-359-5085; Info.: 313-846-3922.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 510-447-9570.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders: 800-621-2248; Info/IL: 312-332-2000.

Canada:
KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

© 1994

MEADE
THE LEGEND CONTINUES...

16" LX200

Professional instrumentation for the demanding school, college, or university research program—or as the ultimate personal telescope for the advanced amateur.

Professional-grade 16" f/10 optical system meets or exceeds advanced requirements; includes BK7 correcting plate for high UV transmission and EMC super multi-coatings. ■ **Massive one-piece fork mount** permits substantial auxiliary equipment to be piggybacked with rock-solid stability. ■ **Large 11" worm gears** on both axes, with factory-programmed Smart Drive™; periodic error less than 5 arc seconds. ■ **Automatic GO TO capability** to any object in the onboard 64,350-object database or to any input R.A. and Dec. ■ **High-Precision Pointing™** to within one arc-minute in the GO TO mode. ■ **DC servo drive systems** with integrated encoders and planetary gearboxes; encoder resolution: 0.13 arc secs. ■ **Six pushbutton-controlled drive-speed rates,** from photo-guide to fast-slew on both axes, simultaneously. ■ **Micro-processor controlled sidereal-rate tracking** in AZ or EQ modes with quartz accuracy. ■ **Home-Pulse Acquisition** permitting remote alignment and operation through a modem link to the telescope's RS-232 interface. ■ **Control panel connectors** for optional systems including CCD autoguiders and imagers, electric focuser, and the Meade **#1222 Field De-rotater** for long-exposure astrophotography in the AZ mode. ■ Available with **supergiant transportable field tripod** (2-person field set-up in less than 10 minutes); **permanent altazimuth pier** (permitting the entire instrument to be housed in a 2-meter dome); or **permanent equatorial pier** (in cases where piggybacked astrocameras do not permit field de-rotation).

The Meade 16" LX200 is in continuous production at the Meade Irvine, Calif. factory. **Delivery time:** 4 to 12 weeks, depending on order status. **Price:** $14,950, complete with supergiant field tripod, plus $385 packing and shipping in the 48 states; prices slightly higher with permanent altazimuth or equatorial pier.

For your copy of the all-new **1994-95 Meade General Catalog** ($3.00), write Meade Instruments or contact your authorized Meade Advanced Products Dealer.

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur

16542 Millikan Avenue, Irvine, Calif. 92714 □ (714) 756-2291
FAX: (714) 756-1450

© 1994

3" VIEWFINDER
$49.95
Complete
LIMITED QUANTITIES
add $5 S&H US – diagonal & eyepiece not included

3" f/4.5 Multi-Coated Achromatic Objective
mounted in machined aluminum cell with 1 1/4" helical-lock focusing & extension tube for straight-through viewing. Plans for easy-to-make collimating mounts included. Sound too good to be true? It will be when they're gone! Order early – WHILE SUPPLY LASTS.

1-719-495-3828
CREDIT CARD ORDERS
BLACK FOREST OBSERVATORY
Department AS2
12815 Porcupine Lane
Colorado Springs, CO 80908

Get your free
F.C. Meichsner Co.
mail order price list!
Just write us at
182 Lincoln St.
Boston, MA 02111
Or call us at
1-800-3-2-1-View
and ask for one!

New Release!
MegaStar
for Windows
Make incredibly detailed custom finder charts with your own PC!

- Hubble *Guide Star Catalog* with over 15 million stars to magnitude 15.5.
- 84,000 deep sky objects. A wealth of information right at your fingertips.
- Powerful database utility to generate filtered lists of objects, add your own objects, and modify existing data.
- Full complement of display functions: Field size/position to nearest arcsec, zoom, pan, locate/identify objects, inverted/reversed views, night vision mode, CCD framer, Eyepiece View, magnitude filtering, and *much more*.
- Generate professional quality charts at the full resolution of your printer.
- Plot comets and asteroids. Data for 5,000+, or add your own elements.

CD-ROM: $99, Diskettes: $149
Check/Visa/MasterCard accepted. 30-day money back guarantee if not delighted.

E.L.B. Software
8910 Willow Meadow Dr.
Houston, TX 77031-1828
(713) 541-9723 (voice/fax)

from imperfections in your own eye and specifically mentioned astigmatism.

I have a new high-quality refractor. It may have near-perfect optics, but to my eye all stars I see with it are V-shaped. This isn't due to a defect in the telescope or eyepieces, but a defect in my observing eye. Thus any telescope, to my eye at least, would "fail" the tests.

Why? I have a cataract forming in my eye which has become quite noticeable over the past couple years. (No doubt it's due to UV exposure during 30+ years spent working outdoors in the horticulture trade.) Yet this eye imperfection hasn't dampened my observing enthusiasm — it just makes it that much more challenging. If your telescope or eyepiece optics aren't picture perfect — don't despair. Just try to make the best of it. In other words, keep observing! — *Christopher E. Spratt, Victoria, B.C., Canada; uc247@freenet.victoria.bc.ca.*

Schiaparelli's Martians?

I very much enjoyed Bruce Bond's "100 Years on Mars Hill" (June 1994), especially because my family lived in Flagstaff from 1986 until 1992. However, the author continued an error that has somehow crept into the conventional wisdom about Percival Lowell and his Martian canals. Bond says that "*canali* translates into 'channels,' not 'canals,'" and indicates that channels are natural streambeds whereas canals are artifacts made by living beings. This interpretation is wrong.

Although *canali* can mean natural channels, the word is more commonly used by Italians to refer to waterways that have been dug or modified by humans ("channelized," as you would say in the United States). Therefore, although Italians refer to the English Channel as "il Canale della Manica," they also use the word to describe "il Canale di Panama," "il Canale di Suez," and "il Canale di Venezia." Italians also use *canali* to describe irrigation ditches, drainpipes, theater aisles, and television channels.

It may be true that Giovanni Schiaparelli was thinking of natural channels when he used the word *canali* to describe the structures he believed he saw on Mars, but this cannot be determined precisely without the full context of his descriptions. — *Dennis Dykstra, Rome, Italy*

Land and Sky Come Together

While I thoroughly enjoyed Frank Zullo's article "Joining Land and Sky" (June 1994), I thought it unfortunate that he chose to make composite images rather than be in the right place at the right time. Granted, the latter requires a lot more planning and work, but the resulting photographs appear more real. The images are beautiful but appear fake to me, which lessens their effect. — *Peter Guerard, West Hartford, Connecticut*

Taking a Crack at Charon

I took the challenge of trying to look for Pluto's satellite Charon on the night of April 16/17, 1994, when it was near greatest northern elongation, according to your chart in the May issue.

The transparency was very good, with magnitude 6.5 stars pretty easily visible at the zenith. I think the visibility of the satellite may be greatly dependent on the seeing conditions. They were quite variable during my observation, typically coming in at 1.5". Occasionally, though, seeing would settle down to subarcsecond. Even during these moments, I could not see any extension to the north of Pluto's Airy disk, something that would indicate seeing Charon. — *Tom Polakis, Tempe, Arizona*

High-Impact Praise

Thank you for publishing "High Impact Astrophotography" by Mark Coco (April 1994). I'm an amateur photographer who wanders the city photographing people and nature. However, I'm always looking to capture something out of the ordinary, and this article gave me step-by-step methods of how to shoot the planets. — *Nicole Brandon, Kanata, Ontario, Canada*

M13 Does Have Dark Lanes!

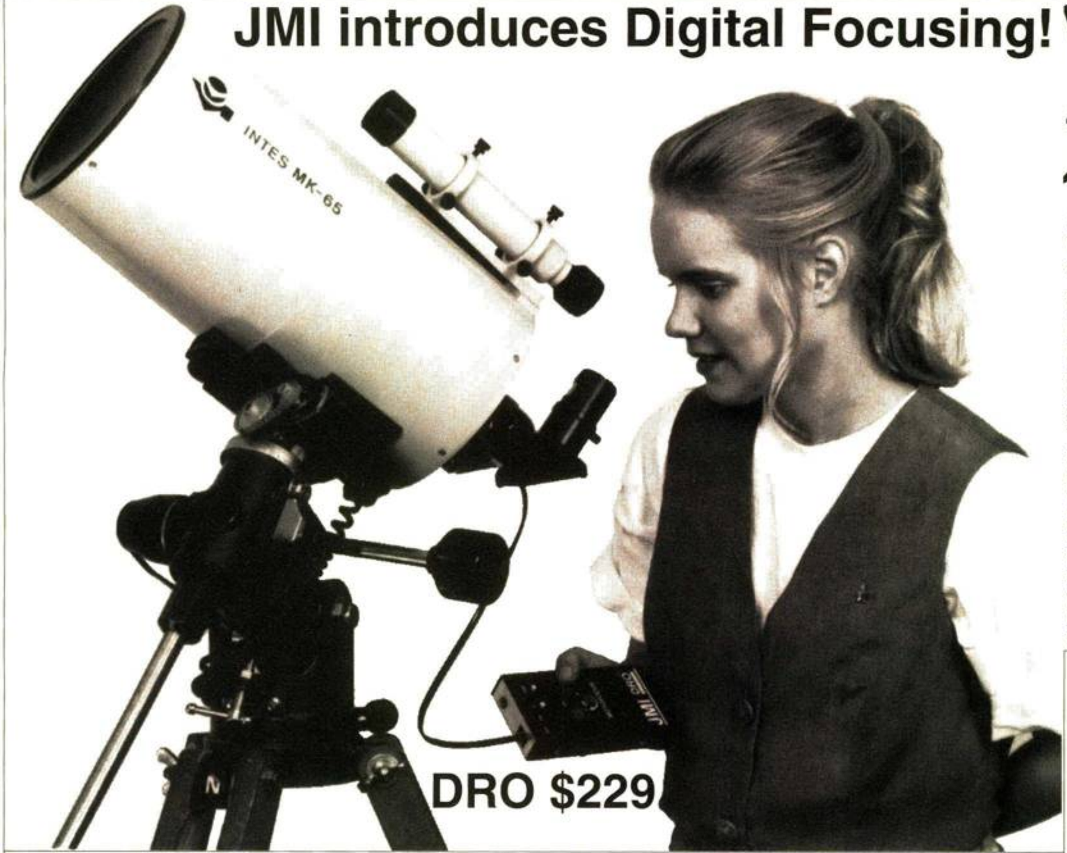
I had to smile when I saw the photo of M13 in the April Sky Almanac. It quite clearly shows the dark lanes that some observers claim are an illusion. The intersection of the Y-shape in the dark lanes is oriented at the top of the image. I've found that spotting these lanes requires at least a 6-inch telescope and 200x. In fact the lanes appear more prominently as you move up to the 16-inch class of scopes.

In 1855 Lord Rosse stated the lanes "do not join in the center, but to the southeast." Yet observers today often mistakenly look for the dark lanes in the middle of the cluster and wonder why they can't find them. — *Alister Ling, Edmonton, Alberta, Canada* ☐

ASTRONOMY welcomes suggestions and additional information about articles and astronomy in general. Send your letters to ASTRONOMY Letters, P.O. Box 1612, Waukesha, WI 53187, or on Internet, use 72000.2704@CompuServe.com. Letters may be edited for length and clarity.

JMI introduces Digital Focusing!

ANOTHER FIRST!



JMI has done it again!

We've created the first commercial unit with precision display of focuser position!

Now you can easily and reliably return to a desired focus position. Great for multiple eyepieces, cameras or CCD's!

The all-new **DRO** (Digital Read Out) unit features variable-speed, bi-directional focus motor control with large (9/32"), red LED display of position to one-hundredth of a millimeter. The display has four brightness levels and a resettable zero position.

When equipped with both **MOTOFOCUS** and **DRO**, some focuser models can no longer be focused manually.

OFF ON
ZERO
DIM
MOTOFOCUS
DRO
JMI

The **DRO** includes hand unit with **MOTOFOCUS** control and digital display, an optical encoder with mounting for your choice of focuser (JMI **NGF/NGF-mini** series, Astro Physics 2.7" focuser, Tele Vue refractors, and Meade #67/#680/#682 focusers currently supported), one alkaline 9 volt battery, and cabling. While a focusing motor is highly recommended, the **DRO** will function as a display unit even if no motor is present.

DRO for existing **MOTOFOCUS** or manual	**$229**($3)	**DRO** with **MOTOFOCUS**	**$299**($5)

This is the opportunity of a lifetime!

Own a high quality 6" f/10 Maksutov-Cassegrain telescope for a fraction of what you would expect to pay.

Aperture-for-aperture, the Maksutov is recognized to be superior to any other telescope design. **JMI** stands behind these little beauties from Russia.

MK65 Optical Tube Assembly	**$895**($16)
Eyepiece package (30mm/18mm/3X Barlow)	**$110.00**
Adaptor Plate for Polaris/Super Polaris/Great Polaris	**$29.00**
for GM-8 and G-11	**$50.00**

"I, as well as two other experienced observers, have been comparing the Intes **MK65** to the Quantum 6", and we all agree [the **MK65**] is equal in resolution and equal or better in contrast." - S. Dunne

"The Intes optics are superb! Several of my observing friends and I have been comparing the **MK65** side-by-side with the Questar, and the **MK65** is right there. When you consider the portability, optics and price, it's incredible." - D. Murray (45 years experience)

"I haven't seen a set of optics to match this in any telescope for quite a while...they are *bloody superb!* My Ronchi screen shows absolutely straight lines." - C. Garner, Australia

Order this industry-first products catalog on video for only $10 ppd., and we'll **DOUBLE YOUR MONEY** with a $20 gift certificate. (Add $10 for overseas PAL version. VHS tape format only.)

Industry First Video Catalog

Jim's Mobile Inc.

810 Quail St. Unit E
Lakewood, CO 80215 • USA
Orders: 800-247-0304
Info: 303-233-5353
FAX: 303-233-5359

PHONE/MAIL ORDER: VISA, MasterCard, personal check, or money order. **USA & CANADA:** Add shipping charge shown in (parentheses) after price. **OVERSEAS ORDERS WELCOME:** Send VISA or MasterCard number with expiration date, or bank check in US$; add 7% of price for customs preparation and air mail shipping ($15 minimum). Prices subject to change.

S94HP

JMI is the only authorized U.S. importer of INTES telescopes.

Each is manufactured to our specifications. When purchasing through another U.S. retailer, be sure a JMI warranty card is included.

NEW!!! 1.25" NGF from $79!

Each model of our popular **NGF** focusers is now available in 1.25"! (Refer to column at right for model details. References to 1.25" adaptor apply to 2" models only. $3 S&H)

NGF-mini1	**$169**	**NGF-mini4**	**$79**
NGF-mini2	**$129**	with **MOTOFOCUS** add	**$80**
NGF-mini3	**$99**	**NGF-miniS**, motorized	**$199**

Only JMI has Black Holes and Quasars!

SPANISH
NGC-miniMAX
JMI
NGC-MAX
M104
GUIDE
NGC micro-MAX
JMI

NGC-microMAX, 245 objects	**$449**($5)
NGC-miniMAX, Planets, polar align help, 3800+ objects!	**$569**($5)
NGC-MAX, Planets, polar align help, RS-232, 12,100 objects	**$769**($5)

Our popular "**MAX**" computer units are ready to use with your choice of over 70 models of commercial telescopes. They feature high resolution (0.09°) optical encoders and do not require polar alignment or leveling! Easily find any object in the computer's database, even add your own! Ask for our free encoder installation instructions detailing how our encoders mount to your own telescope.

from **$119**

Patent # 5303090

Zero image shift!

"To put it bluntly, if there's a better line of commercial focusers made for imaging, I don't know about it." - Dennis di Cicco
March, 1994 *Sky & Telescope*

NGF-1 Top-of-the-line, designed to make your telescope a showpiece. Polished aluminum body standard, black upon request (drawtube always black). Includes 1.25" adaptor. Lifts up to 5 pound load.

manual, 6 SS bearings*	**$229**($3)

NGF-2 Superior for manual focusing. Includes 1.25" adaptor. Black only. Lifts up to 5 pound load.

manual, 4 SS/2 AA bearings*	**$179**($3)

NGF-3 Advanced focusing system. Includes 1.25" adaptor. Black only. Lifts up to 2.5 pound load.

manual, 4 CB/2 AA bearings*	**$149**($3)

NGF-4 Advanced focusing system for the budget-minded. Single focusing knob. Non-coated aluminum body. 1.25" adaptor optional. Lifts up to 2.5 pound load.

manual, 4 CB/2 AA bearings*	**$119**($3)
2"-1.25" adaptor	**$19.95**

Order **MOTOFOCUS** with above add **$80**
(You save $29.95 over regular price!)

*SS=Stainless Steel, CB=Composite/Brass, AA=Anodized AL.

Meade Plossls As Low As $49.00

Save on these Meade Accessories for a limited time only!

911B Nebula Filter	$90
911N Nebula Filter	100
f:6.3 Focal Reducer	115
Tele Extender	27
Variable Tele Extender	36
56mm Super Plossl *and* #929 Diagonal; both for only	$230
#62 Camera Adapter	23
#929 2-inch Diagonal	90
40mm Plossl 1.25"	70

New! Meade Pictor Series CCD Autoguiders and Imagers from $395

See Meade ad or send $3 for full-line Meade Catalog!

NEW!

Meade Series 3000 Plossl Eyepieces:
5, 6.7, 9.5, 16, or 25mm
- Made in Japan
- Multi-coated
- 4-element!

$60 each
Any 2 for $53 ea.
Any 3 for $49 ea.

40mm S3000 Plossl in stock for only $70

Meade Barlows:	
#122 2x 1.25"	$48
#127 2-3x 1.25"	60
#134 2x .96"	40
#140 2x 1.25"	80
2045 Accy's:	
Barlow 126 2x	48
Car cord	20
Carrying case	80
Tripod & wedge	265
Starfinder Accy's:	
Dust caps	call
Dec 55	80
Drive 43 110v-12v	99
Drive 47M (6-8-10)	399
Drive 48RS (16")	469

Misc. Meade	
Accy case 50	$67
Diagonal 1.25"	42
Diagonal .96-1.25"	28
Diagonal .96" 45°	53
Diagonal 1.25" 45°	53
Diagonal 929 2"	Sale
EP holder 1.25"	25
Focuser 67 1.25"	60
Focuser 680 2"	100
Focuser 682 2"	100
Finder brkt-8x50	20
Finder 544-8x50	70
Finder 545-8x50	70
Finder 637-6x30	50
Finder 957-9x60	100

Filter set of 4	$55
Filter set of 8	99
Filter set of 12	145
Filter ND96 1.25"	18
IBM software-200	100
Illum 12mm w/cord	80
Illum 12mm-wless	100
Illum 9mm w/cord	130
Illum 9mm-wless	150
Lenshood 8"	114
Lenshood 10"	124
Nebula 908B	80
Nebula 908N	90
Nebula 911B	Sale
Nebula 911N	Sale
Object libraries	call

Off-axis guider	$80
Piggy bracket	32
Polar finder 814	95
Skylight/seal	48
Tele extender	Sale
Tele ext-variable	Sale
T-adapt: SC	Sale
T-adapt: vari-proj	40
T-adapt: .96"	30
T-adapt: 1.25"	30
T-rings	16
Vari pol 905	50
Weight set 8"	85
Weight set 10"	90
Wedge 8"	110
Wedge 10" Super	395

Meade Series 4000 Eyepieces:	
Super Plossl 6.4, 9.7, 12.4, 15, 20, 26	$88
SP32 or 40mm	110
SP56mm	Sale
Super Wide 13.8	160
Super Wide 18	170
Super Wide 24.5	199
Super Wide 32	280
Super Wide 40	340
Ultra Wide 4.7	180
Ultra Wide 6.7	220
Ultra Wide 8.8	270
Ultra Wide 14	330

Ask about our Special $10 UPS AIR Accessory Delivery!

Jim's Mobile

Moves in-out

Zero-Image-Shift Electric Focus!
*Fits **ALL** Meade and Celestron SCT's!*
$189 1.25"
2-inch NGF-S $269

LX200 Keypad Holder
$32

Leveling Wheels!
Fits any Meade
8"/10" SCT, 4"/5" APO, and Starfinder 6"/8"/10"
$138

Telrad
Call

TeleVue

Genesis SDF	Call
Pronto	Call
Renaissance	Call
Panoramic mt	349
Gibraltar mt	449
Starbeam-T	179
Cam. adapter	39
Piggycam	45
Eyepiece proj	69

Ext tube	$33
CXD-1 motor	234
Polar finder	119
Air Chair	119
Nagler:	
4.8mm	149
7mm	184
9mm	219
12mm Type2	249
16mm Type2	284
20mm Type2	339

Plossl:	
7.4, 10.5, or 13	$ 70
17, 21, or 26	70
32 or 40mm	99
55mm	219
Wide Field:	
15mm	134
19mm	139
32mm	234
Paracorr 1.25"	139
Paracorr 2"	214

Panoptic:	
15mm	$199
22mm	249
27mm	299
35mm	324
Barlow interface	94
Barlows:	
1.8x	79
2.5x	79
Big Barlow 2"	154

Sale!
Foam Lined Accessory Case!
Large! 13x19x7" $50

Celestron

Ultima 2000	Call
C5+ w/wedge	Call
C5 tripod	259
C5 fitted case	137
C5 dec motor	95
C5 lenshood	49
C5 piggyback	63
Dew shield-8"	29
F:6.3 reducer	129

MFFT-55	149
Piggy brkt. 8"	$32
Radial guider	124
Tele ext. Deluxe	48
Ultima 2x 1.25"	79
Lanthanum EP	Call

NEW! Only $349
Al-Azimuth wood field tripod with slo-motion controls. Has 1/4-20 mount for all spotting scopes!

1000 Oaks Solar Filters

4" full-aperture	$ 70
5" full-aperture	90
8" full-aperture	115
10" full-aperture	129

Other sizes in stock!

Precision polished glass, triple-coated in machined aluminum cell. Image is yellow-orange— no need for secondary filtering!

Konica
ASA 3200 Color Print
4-24 exp. rolls $27

1994 Discount Buying Guide Available!

NO CREDIT CARD SURCHARGE! Shutan is family owned **AND** operated since 1918! Order by **NOON** for same-day shipment. Don't be **FOOLED** by other stores with tons of fine print in their ad! We ship most acc'y orders UPS Ground for just **$4.50.** Call for $10 UPS AIR info. Call for telescope prices & stock status. *Prices subject to change.*

Call Us Toll-Free 800-621-2248 • Ilinois 312-332-2000

SHUTAN
camera & video

312 W. Randolph • Chicago • 60606
M-F 8:30-5:30 • Saturday 9-5

VISA MasterCard DISCOVER AMERICAN EXPRESS

VIEWPOINTS

Antarctic Odyssey

by John V. West

Sometimes to find our place in the world we have to travel to the ends of the Earth. That's what happened when I was offered a job at Antarctica's McMurdo Station by Antarctic Support Associates, a civilian contractor that provides logistical and operational support for the National Science Foundation's Antarctic program. From August until October 1993, I supervised the maintenance of McMurdo's fleet of more than 400 vehicles. As a spin-off, I got to do some polar astronomy and experience first-hand some of nature's dynamics.

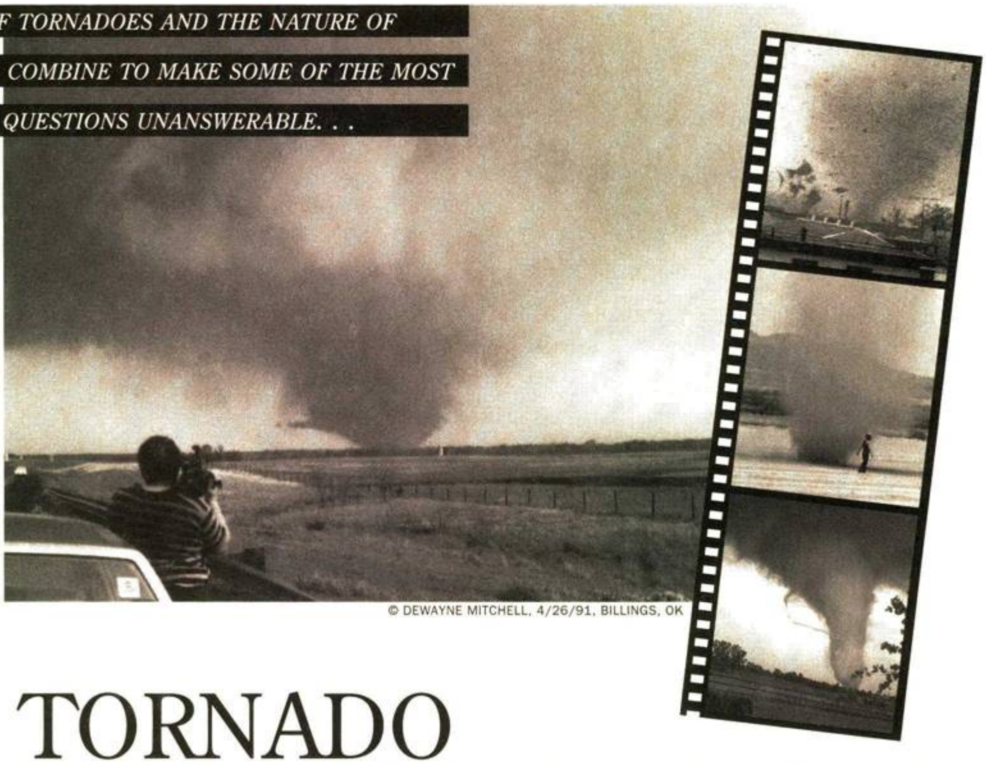
Being an avid amateur astronomer, I was looking forward to my first view of the southern sky. There would be plenty of time to take in the sights; for the most part, the sky is dark between August and the beginning of the busy season in October. During that time, Antarctica experiences winter and a bone-chilling cold accompanies the darkness.

Wintertime observing in my native Colorado necessitates warm clothing, but nothing like what's needed near the South Pole. Selecting the right clothing for a polar observing session is an art in itself. The list of gear sounds like something from an astronaut's checklist: thermal socks, polypropylene long johns, fleece trousers and jacket, a heavy wool shirt, nylon wind pants or bibs, "bearclaw" mittens with wool liners, neck gaiter (a tubular scarf) and balaclava, waterproof "bunny boots" (oversized, super-insulated winter boots), and a state-of-the-art goose-down parka and overall.

Keeping warm on the inside is also important. A hot beverage is always welcome but of greater concern is dehydration, a serious problem in this driest of climates, which averages 2% humidity. We were encouraged to drink at least five quarts of water a day and to avoid caffeinated beverages and alcohol.

The dry climate and dark skies of Antarctica make for prime observing. But getting away from McMurdo's heavily lit compound can be a problem. During the Antarctic night, strict rules limit travel away from the station, and those leaving the base have to travel with a companion and file a "footplan" outlining destination and return time. Failure to report one's return will trigger a massive and expensive search and rescue effort.

THE NATURE OF TORNADOES AND THE NATURE OF HUMAN BEINGS COMBINE TO MAKE SOME OF THE MOST FUNDAMENTAL QUESTIONS UNANSWERABLE. . .

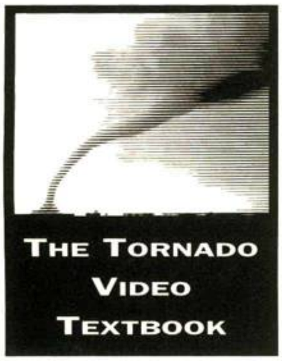


© DEWAYNE MITCHELL, 4/26/91, BILLINGS, OK

110 TORNADOES ON VIDEO AND 150 PAGES IN PRINTED GUIDEBOOKS

TORNADO VIDEO CLASSICS I & II

THE TORNADO VIDEO TEXTBOOK



TORNADO VIDEO CLASSICS I

is internationally acclaimed as the finest and most complete tornado video program in existence. It combines the 68 most famous and spectacular tornadoes with a dozen research experiments and a 3,600-word narration. You'll see merging tornadoes, tornado families, a cockpit view of rockets being fired at tornadoes, model tornadoes compared with close-ups from a helicopter, multiple vortex tornadoes, successful chases with portable Doppler radar and TOTO, telephone poles on rocket sleds to simulate tornado missiles, and much more. Each scene is numbered on the screen and keyed to the 50-page, 14,000-word printed guide.

TORNADO VIDEO CLASSICS II

uses 42 tornadoes not seen on TVC I to add a new dimension to the study of tornadoes on video. This production emphasizes human–tornado close encounters—what these reveal about risk to human life and the seemingly unsolvable puzzles of tornado climatology. The video also takes a side-journey into the world of "Mr. Tornado," Professor T.T. Fujita, with spectacular tree-snapping, roof-flying footage in hurricanes and downbursts. The 100-page video guide is a treasury of severe storm information. It includes details on all scenes in the video and adds a 200-term glossary of severe storm and tornado spotter/chaser terminology.

ASK US ABOUT OUR SPECTACULAR TORNADO POSTERS

Ask about our 1350-page book *SIGNIFICANT TORNADOES*, 400 photographs, 200 maps, 150 illustrations, nearly 1,000,000 words... the acknowledged "bible" of tornado information.

Clip and Mail Today!

Complete form and send to:
Tornado Project, Box 302A
St. Johnsbury, VT 05819
or call **802 748-2505**

Send Me:

__*Tornado Video Classics I* (2-hour video, 50-page guide) $35

__*Tornado Video Classics II* (2-hour video, 100-page guide) $39

__***Both*** tapes/guides . . $65

Above prices include priority rate postage.

Overseas Orders:
Add $12 U.S. per order for air postage.
P.A.L. format available.

NAME __________

ADDRESS __________

CITY __________ STATE __________ ZIP __________

Method of Payment

☐ CHECK ENCLOSED (Payable to TORNADO PROJECT) FOR $ __________

☐ PURCHASE ORDER ATTACHED, NO: __________

CHARGE MY: ☐ MC ☐ VISA PHONE, DAYS ( ) __________

CARD NO. __________ EXP DATE ____ / ____

SIGNATURE __________

A

MoonRise

Enjoy the rising of the moon as illustrated by Allan Eaton.

A full color print measuring 11" x 40" for only $17.00.
Send to: Allan Eaton, P.O. Box 596, Brigham, UT 84302
Please add $3.00 for shipping & handling.

A CLASSIC RETURNS

Enjoy the quality of a hand crafted scope by Steve Dodson for only $189.00

- Carry it out in one hand...
Sharp wide-field sky views are only moments away.
Total weight only 7lbs.
- Exceptionally smooth steady wood mount and tripod
- 1 1/4-inch standard eyepiece gives 42 power
(substitute other standard eyepieces to get up to 125 power)
- Easy-aim "gun sight" finder

Sgr-3
Reflecting Telescope

Write: Stargazer Steve, 1752 Rutherglen Cres., Sudbury, Ontario P3A 2K3, Canada Phone: (705) 566-1314

ISA Bus CCD Cameras

Standard Camera
EDC-1000 192 x 330 pixels
Cooled
EDC-1000TE 192 x 330 pixels
Monochrome/High Resolution
EDC-1000HR 753 x 488 pixels
24 Bit Color/High Resolution
EDC-1000C 751 x 488 pixels

Cameras priced from $400 to $950
C-Mount lenses are optional

- IBM PC Bus Interface Card is Included
- 1.6 x 10^6 pixels/sec (Camera to RAM)
- Sub-Array Scanning
- Long Cables (50 to 100 feet)
- False Color Display
- Antiblooming
- TIFF, PCX, TARGA and FITS Formats
- Image Co-Addition (up to 15 Bit Gray Scale)

NOTE: Image Co-Addition allows uncooled cameras to image deep-sky objects.

ELECTRonic IMaging

ELECTRIM Corporation
356 Wall St.
Princeton, NJ 08540

(609) 683-5546 Fax: (609) 683-5882

Because of these constraints, I planned to do my observing with the naked eye. Weight restrictions required me to leave my 10x70 astronomical binoculars at home, but soon after my arrival I found a pair of beat-up 7x50s lurking in a desk drawer. One objective lens was badly cracked, but they were better than nothing.

That first night at the station the sky was clear, so after dinner I grabbed the binoculars and set out for my first session under polar skies. I didn't have an observing partner and hadn't filed a footplan, so I had to settle for a nook between a pair of D-9 Caterpillar tractors that shielded me from the street lights of McMurdo.

Delight of delights! Even the decrepit binoculars revealed the most incredible star fields imaginable as I swept through the Milky Way from Centaurus to Carina. I scrutinized the Large Magellanic Cloud and the Tarantula Nebula and noted the twin beacons Canopus and Sirius pointing toward more familiar northern skies. Tucked away to the west of Centaurus was tiny Crux, the Southern Cross, with its Jewel Box star cluster.

My eyes never became totally dark adapted. A wind chill of –72°F and my lack of acclimatization to the cold cut the night short. I was a frozen but happy man as I returned the star chart to its place on my wall. This had been one of the most exciting observing sessions of my life.

But the best was yet to come. The next morning I was on my way to breakfast in darkness. I looked up to see Canopus and Sirius and found I had missed Canis Major the night before. Its odd appearance threw me off for a moment until I realized it was inverted. Once-familiar objects appeared alien. My whole world seemed upside down.

This strange region of the world harbored still more intriguing sights. Outside my office window, nearby Observation Hill rose into the sky at an improbable angle, a volcanic fang 700 feet high. One morning I gazed out to see a Full Moon approaching the hill. I had seen plenty of moonsets before, but at this latitude the Moon travels around the horizon at nearly a constant elevation. It approached the mountain sideways; in a rush of enlightenment I was both watching and feeling the Earth rotate on its axis, a fundamental dynamic of nature.

My Antarctic experience instilled a deeper sense of knowledge, like when I first felt the magical beauty of mathematics. Through epiphanies such as these the grandeur and majesty of universal truths hit home.

Of one truth I'm certain: A long Antarctic night does wonders for the soul. ☐

ON THE EVENING OF August 21, 1993, Steve Bisque in GOLDEN, COLORADO established modem contact with the 24-inch telescope at the Mt. Wilson Observatory *outside* Pasadena...

...he also grabbed a slice of history.

Using TheSky™ astronomy software and simple mouse clicks, Steve ordered the California telescope, more than 1,000 miles distant, to slew and lock on a medley of celestial objects. He collected more than a dozen images without a hitch.

It's hard to overstate this achievement. The applications of remote operation for professional, amateur, and scholastic astronomers are staggering.

*Still, we're no less proud of TheSky's other contributions to astronomy. Take, for instance, its highly acclaimed professional-quality star charts, CCD image processing, and stunning databases containing up to 19-million objects (including the Guide Star Catalog).**

There are simpler joys too, like its user friendly Windows™ interface, optional CD-ROM media, and simple upgrade path to professional versions. Not to mention lightning execution.

JUST FOR THE RECORD GLOBULAR CLUSTER M14 WAS THE FIRST CCD IMAGE TAKEN!

WHAT'S IN IT FOR YOU!

- Computer-Directed Telescopes
- Remote Astronomy
- CCD Astronomy
- Image Processing
- Professional-Quality Star Charts

With all this, it's easy to see why TheSky is the world's leading astronomy program for professional and amateur astronomers.

So pick up a copy of TheSky and take your own shot at history.

THESKY™
Astronomy Software

One Step Closer to the Ideal
1. 800. 843. 7599

Software Bisque
912 Twelfth Street, Suite A
Golden, Colorado 80401
Fax: 303. 278. 0045
International: 303. 278. 4478

SOFTWARE BISQUE

Acknowledgements:
Mt. Wilson Institute, California Institute of Technology, Merlin Controls Corporation, Meade Instruments Corporation, Santa Barbara Instrument Group, and Jet Propulsion Laboratories.

*ALL FEATURES ARE AVAILABLE IN THESKY REMOTE ASTRONOMY SOFTWARE.

THESKY IS A REGISTERED TRADEMARK OF SOFTWARE BISQUE.

Broken Promise

Bright Vega in the constellation Lyra has long served astronomers as a standard star, one they could use to calibrate the properties of other stars. Because it is the fifth brightest star in the night sky, Vega helped define the scales of stellar temperature and brightness, making it the most important star after the Sun. But now a group of astronomers believes it isn't a good star to use as a standard.

Because the star seemed to rotate slowly (once every five days), researchers had assumed that its temperature was constant over its surface. Graham Hill of the Dominion Astrophysical Observatory in Victoria, British Columbia, and his colleagues confirmed what many astronomers had suspected — the star rotates quickly (once every 11 hours) but is viewed pole-on, making it appear to rotate much more slowly than it actually does. Vega's fast rotation distorts the star slightly, causing the equator to bulge compared to the poles. The distortion also makes the poles hotter than the equator, ruining its use as a temperature standard.

The change in temperature across Vega's surface explains puzzling observations of the star, such as its larger-than-expected size and the too-low temperature for its brightness.

The fast rotation shouldn't affect Vega's brightness, however, so astronomers don't expect the star's role as a brightness calibrator to change.

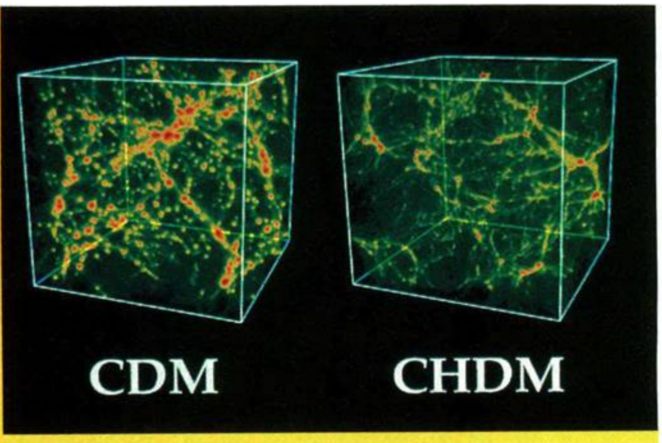
Russians Say Mars Can Wait

Plagued by money problems and schedule slips, the Russians have decided to delay their Mars '94 mission to a 1996 launch date. The United States, France, Germany, and Finland were working with the Russians on the program, which would have seen two surface penetrators and a hard lander delivered to the Red Planet in 1995.

The postponed mission now joins a Russian and French effort to deliver balloon-borne experiments to Mars' surface in 1997. The United States also intends to launch its Pathfinder

THE VERY LARGE TELESCOPE IS UNDERWAY on Cerro Paranal, about 80 miles south of Antofagasta, Chile. Being built by the European Southern Observatory, the four 8.2-meter optical telescopes making up the VLT will occupy the excavated regions shown in this aerial photo. The white lines mark the sites of several structures that will connect the telescopes, permitting astronomers to combine images from the scopes.

The Biggest and Best Model of the Universe



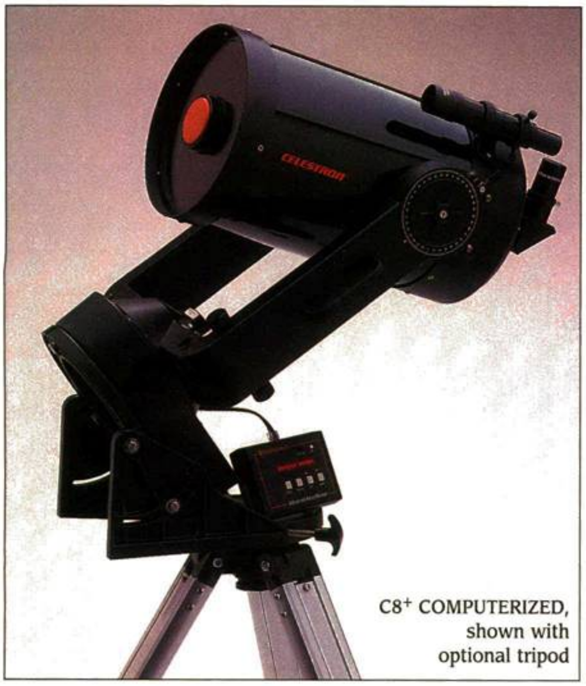
Theorists agree: Models of the universe must include dark matter to properly account for the evolution of the cosmos. But until now, they have split on the form of dark matter to include in the models. Unfortunately, both cold and hot dark matter models poorly described the real universe.

Cold dark matter (CDM) models form small structures such as galaxies first and then larger structures such as galaxy clusters. These models, however, produce too many clusters and do not evolve fast enough to yield the large filamentary structures actually seen in the universe. Hot dark matter models build large structures first and then small structures. These models do not generate galaxies fast enough.

Theorists thought of combining the two models, but the prospect was daunting because previous models already strained computing abilities. Now new parallel computers at the National Center for Supercomputing Applications in Urbana, Illinois, have enabled Greg Bryan and Michael Norman of the University of Illinois and a team of theorists to model the universe using a combination of cold and hot dark matter (CDHM). Their 16,000-hour simulation is the first that is sufficiently comprehensive to allow direct comparison with observations.

In particular, the model reproduces X-ray observations made by ROSAT of hot gas in galaxy clusters. The model has about the right number of clusters and produces the correct filamentary structure. So far this model predicts incorrectly the amount of X-ray emission and thus the ratio of gas to dark matter. A simple modification of the model may correct this problem. More important, the model allows theorists to predict other cosmological observations, such as the number of X-ray clusters seen at greater distances. This will enable astronomers to further test the cold-hot dark matter model, which now seems to be the best model describing the universe.

CELESTRON® SUMMER/FALL VALUE SAVINGS



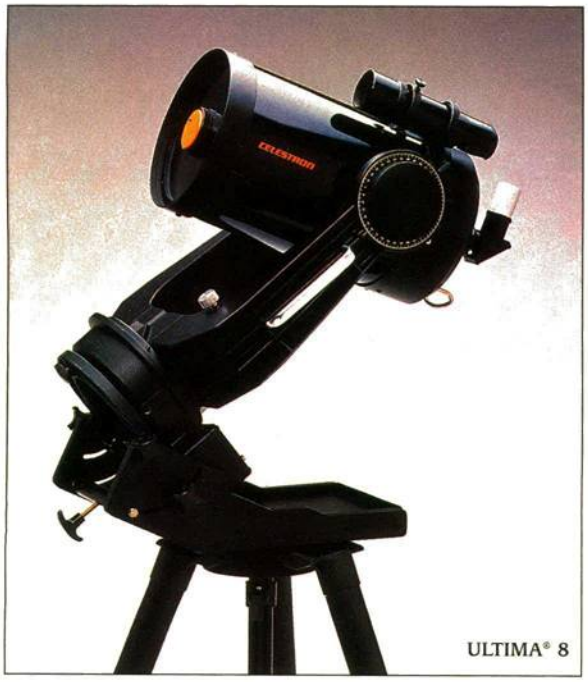
C8^{+} COMPUTERIZED, shown with optional tripod

C8^{+} TELESCOPE — For astronomy on the go, you can't beat the C8^{+}. Runs off a single 9 volt battery for up to 50 hours. No need to be near your car or carry other 12 volt systems with cords all over the place. A hand controller is included as well as a built-in drive corrector. Starbright® coatings are standard. Optical crown glass for the corrector and a properly baffled system ensure the finest optical quality in a Schmidt-Cassegrain system. Standard accessories include: 6x30 finderscope, star diagonal - 1¼", 25mm Kellner eyepiece - 1¼" and wedge.

C8^{+} COMPUTERIZED — Is the same as the C8^{+} with the addition of a **factory installed** and **tested** Advanced Astro Master® to give you a computerized telescope. Once aligned, this unique accessory will guide you to any of the more than 10,000 objects in the data base.

ULTIMA® 8 — For the more serious observer and astrophotographer who seeks the finest Schmidt-Cassegrain optics along with the utmost in rigidity and the most accurate drive system. As with the C8^{+}, the Ultima® 8 runs off a single 9 volt battery. Standard accessories include: a hand controller, 7x50 finderscope, 26mm Plössl eyepiece - 1¼", star diagonal - 1¼", wedge, tripod and rugged foam fitted carrying **case**.

CG-11 — Combines the unequaled optical excellence of the Celestron 11" Schmidt-Cassegrains with a superb German equatorial mount built for Celestron by Losmandy. Standard items include: DC electronics with hand controller, 7x50 finderscope, 26mm Plössl eyepiece - 1¼", star diagonal - 1¼".



ULTIMA® 8

FREE CELESTRON ACCESSORIES

Purchase any of the four telescope models mentioned above between August 1, 1994 and October 31, 1994 and receive **free:**

- With the **C8^{+}** or **C8^{+} Computerized** — Deluxe Accessory Case and Lens Shade
  Free Value — $116.00
- With the **Ultima® 8** — Deluxe Accessory Case, Lens Shade and Piggyback Mount
  Free Value — $166.00
- With the **CG-11** — Deluxe Accessory Case, Reducer/Corrector f/6.3
  Free Value — $266.00

CG-11

To receive your **free** accessories in the U.S.A., send proof of purchase to the Celestron Customer Service Department. Outside of the U.S.A. contact your Celestron dealer or distributor.

ADD THE OPTIONAL ADVANCED ASTRO MASTER® TO COMPUTER CONTROL THE C8^{+}, Ultima® 8 or CG-11

For more detailed information on these telescopes, contact your Celestron dealer or Celestron.

CELESTRON® *LIGHT YEARS AHEAD OF THE COMPETITION*

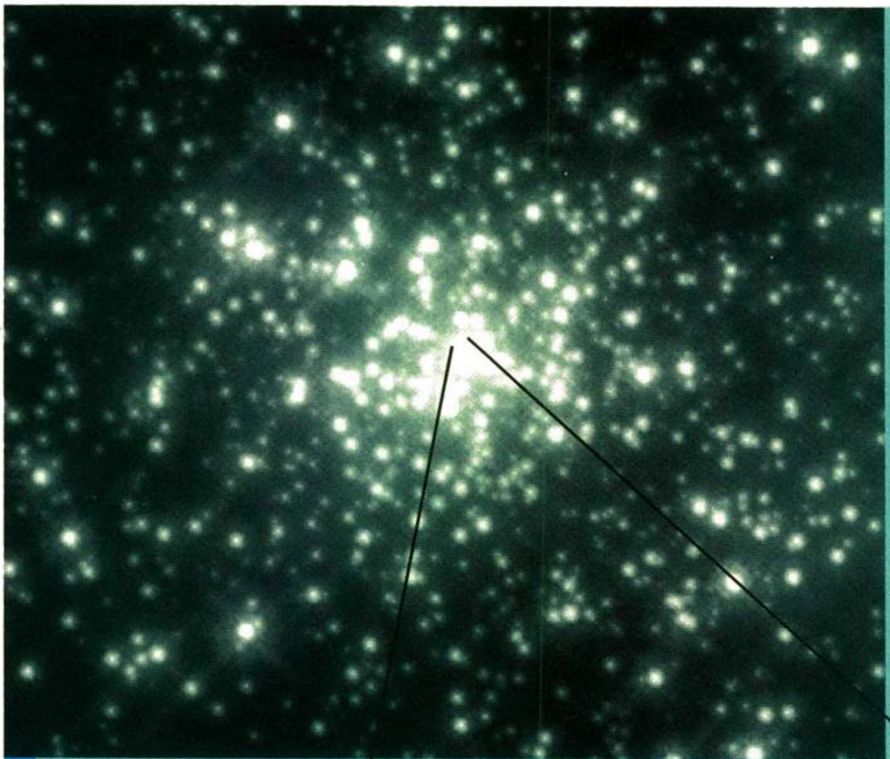
Celestron International • 2835 Columbia Street • Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

lander/rover and Surveyor, a Mars Observer replacement spacecraft, toward Mars in 1996.

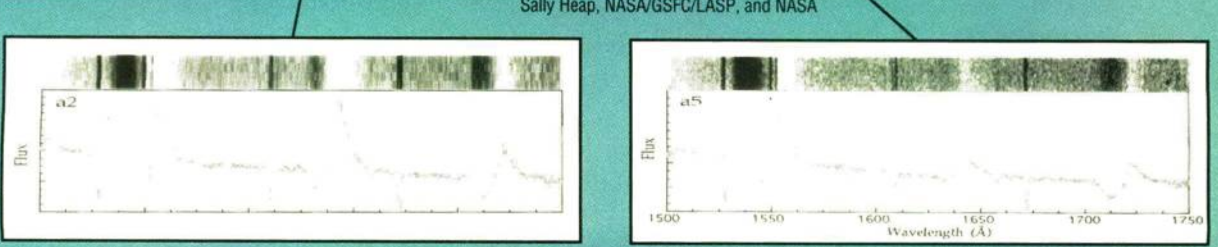
By 1998, Russia and the United States could mount a joint unmanned mission to the planet. During meetings held in June at the Jet Propulsion Laboratory, the Russians presented an option where a Proton booster would launch an American orbiter carrying a Russian rover/ balloon experiment. The 1998 joint mission is being considered by NASA as an alternative to a Mars Surveyor launch planned for that year.

The program calls for a spacecraft to be launched to Mars every other year through the year 2003.

FIVE MILLION SUNS CROWD into globular cluster Omega Centauri. This huge mass places the size of the cluster between ordinary globular clusters that contain only about 100,000 solar masses and dwarf spheroidal galaxies. Georges Meylan of the European Southern Observatory and his coworkers used the 1.5-meter Danish telescope at ESO in La Silla, Chile, to measure the orbital motions of individual stars in the cluster. From these motions, they determined the amount of gravity needed to cause these motions and, thus, the mass of the cluster.



Sally Heap, NASA/GSFC/LASP, and NASA



A REPAIRED HUBBLE RESOLVES STARS all the way to the dense center of cluster R136a, allowing astronomers to study the spectra of individual stars. What they learned suggests that stars have a much harder time forming black holes than previously thought. A Wide Field/Planetary Camera 2 image of the cluster (left), which lies in the Large Magellanic Cloud, reveals hundreds of stars populating the inner five arcseconds. Researchers then took spectra of two of those stars, R136a2 (below left) and R136a5 (below right). R136a5 turns out to be a main sequence O star with 60 times the mass of the Sun, the kind of star expected to form black holes. But it is losing mass at a rate of 20 solar masses every million years — eight times higher than theory predicts. At that rate, the star will lose too much mass in its lifetime to end up as a black hole.

Meade®

ADVANCED PRODUCTS

- SAME DAY SHIPPING
- NO EXTRA CHARGE FOR CREDIT CARDS
- FULL LINE OF MEADE ACCESSORIES

FOR ORDERS ONLY

1-800-359-5085

FOR PRODUCT INFORMATION

1-313-846-3922

MEADE SERIES 4000

"Best Overall Performance"

Plossl test, *Sky & Telescope* magazine

PRECISION CITY camera

OPTICS

15336 W. WARREN • DEARBORN, MICHIGAN 48126

THE NEXT GENERATION CCD CAMERA

CompuScope announces the CCD800/1600 series integrating CCD cameras.

- Low Light Imaging
- Astronomy / Microscopy
- Large Format 768x512
- Thermoelectrically Cooled
- 0 Defect, Scientific Grade CCD
- Upgradeable to CCD1600 - 1536x1024 Array
- Ultra Low Noise – Type. <13 e-
- Low Dark Current – ~0.1 e-/s
- High Dynamic Range
- Optional Integral Filter Wheel
- Fully Self-Contained Control Electronics
- Compact / Transportable / Versatile
- 12VDC - Battery or AC Operation
- PC Parallel Port Interface
- Optional 32 bit Imaging and Control Software
- Enhanced UV Coating Available
- Matched UBVRI, Clear, Hα, Hβ, OIII, SKY-GLOW, Stromgren and Others Available Separately
- Filter Wheels Available for All Your Optical Applications

CCD 800/1600 complete with CCD PC interface and electronics and optional integral filter wheel

CompuScope

Precision Instrumentation + Software
3463 State Street, Suite 431
Santa Barbara, California 93105
Telephone (805) 966-7179
Fax (805) 966-6693; BBS (805) 966-2160

At Roger W. Tuthill, Inc.,
We Don't Just RESHIP Meade and Celestron Scopes as Others Do,
We Test Them Individually.

Our Experience of 21 Years Lets Us Apply a "Personal Touch", Inspecting & Improving the Telescopes We Sell. Our Line of Accessories Makes Them Easier to Use and Gives You Less Hassle. Why Gamble With a Big Volume, Impersonal, Quick-Sale-Mail-Order Company? For Answers or Advice, Call TOLL FREE 1-800-223-1063 and Talk to **Astronomers, NOT Clerks.**

This Month's DELUXE CERTIFIED SCOPE PACKAGE:

Celestron's ULTIMA® 8-PEC Package...$1945. Includes:

- Knot-Free Redwood Isostatic Equatorial Mount – A combination wedge and tripod with built-in latitude adjustment. More vibration-resistant than the standard tripods. Requires only four No-Tool knobs for **quick** set-up. Lightweight, folds up for easy portability and storage.
- Free set of Tuthill Astro-video Instructional tapes.
- 25% off Tuthill accessories when purchased with scope.

Send a 9" x 12" S.A.S.E. with 4 stamps for complete catalog. Includes prices and description of **DELUXE CERTIFIED SCOPE PACKAGES** for Meade 4", 8", 10", & 12" Schmidt-Cassegrains, Celestron C5, C8+, Ultima® 8-PEC, Ultima® 2000, Questar, and Odyssey.

Visit our showroom. We sell binoculars, astronomy books, Lumicon filters, JMI products, software, and pre-owned equipment.

Tuthill Accessories

The very portable 8" C8+

Heatable NO DU CAPS for SCTs and Refractors

80mm Erect Image ULTIMATE FINDER includes bracket and 21mm ocular.

PRECISION POLAR AXIS FINDER® for EXACT polar alignment in minutes.

Roger W. Tuthill, Inc.
11 Tanglewood Lane, Dept. A • Mountainside, NJ 07092 • Phone 908-232-1786 • FAX 908-232-3804
VISA, MC, COD, Personal Checks, Time Payment Plans

Subaru Mirror Sent for Polishing

In June, Corning Inc. of Canton, New York, successfully created the final shape of the mirror for Japan's 8.3-meter Subaru telescope. After fusing hexagonal segments together to form the mirror blank and grinding both of its sides flat, workers reinserted the 33-ton mirror into an oven. The floor of the oven had an elevated center, so when the glass got hot enough, it sagged at the edges and took on the desired meniscus shape. After three years of making the mirror, Corning shipped it to the polisher, Contraves Electro-Optics System in Pittsburgh, Pennsylvania.

News from the World of Space Science . . .

SAN DIEGO, California — A consortium of American and Russian engineering companies has unveiled a prototype spacecraft designed to deliver cargoes of up to 1,300 pounds to the lunar surface. Dubbed ISELA-600, the lander will be marketed internationally for use in exploration or commercial missions. International Space Enterprises and Russia's Lavochkin Association plan to launch the ISELA-600 on a 1997 flight to deliver a lunar rover designed by LunaCorp, another joint U.S./Russian commercial venture.

MOFFETT FIELD, California — About 3.5 billion years ago Mars was a much warmer, volcanically active planet that possessed a dense atmosphere and abundant water. NASA Ames Research Laboratory exobiologist Jack Farmer thinks that microbial life might have had time to gain a foothold before Mars lapsed into a dormant state. (See "Did

AMATEUR NEWS

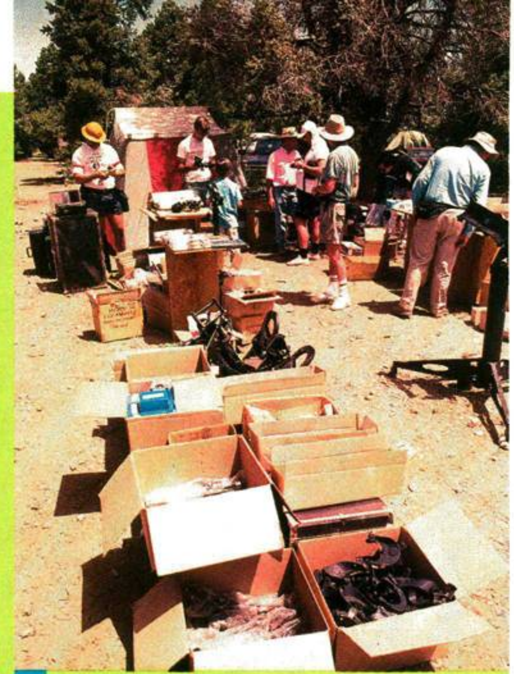
Rendezvous at Riverside

This year's 26th annual Riverside Telescope Maker's Conference in Big Bear, California, had it all: great weather, informative talks, big scopes, dozens of vendors and, of course, cutting-edge telescope technology.

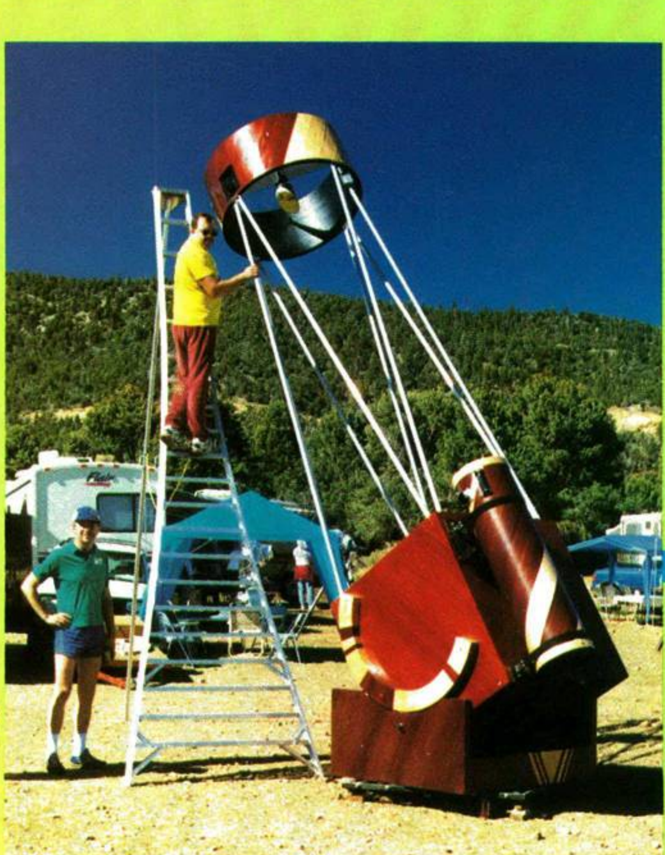
The Mount Wilson Institute presented its Telescopes in Education program, which gives educators and amateurs remote observing time on a 24-inch telescope via home computer. Riversiders selected targets from a star map on a computer display, which commanded the telescope to slew to a desired target. A CCD camera then took an image and downloaded it to the computer, a process that took about ten minutes. The system is now fully operational and can be accessed from anywhere in the country. For more information on observing time and hardware requirements, call the Mount Wilson Institute at (818) 395-7579.

Those who couldn't get time on Mt. Wilson ogled the heavens through Steve Swayze's 40-inch f/5 Dobsonian telescope. It took Swayze four months to grind the mirror in his one-bedroom Portland, Oregon apartment. Dozens of people queued up to observe through the behemoth; getting to the eyepiece required a 15-foot climb up an apple-pickers' ladder.

Next year's conference will be held over Memorial Day weekend, May 26-28. For more information write to RTMC, c/o Fox & Stephens, CPAs, 9045 Haven Avenue, Rancho Cucamonga, CA 91730, or call (909) 948-2205 and leave a message.



PLENTY OF BARGAINS were offered by commercial vendors and amateurs alike. Telescopes, cameras, books, eyepieces — even meteorites — were for sale from tables, truck tailgates or, in this case, boxes.



ASTRONOMY: John Shibley

CLIMBING A STAIRWAY TO HEAVEN, Steve Swayze lends scale to his 40-inch f/2 Dobsonian telescope. He also made the 12$\frac{1}{2}$-inch *"finder" attached to* the main mirror box.

POCONO MOUNTAIN OPTICS

For All Your Astronomical Needs

Tele Vue "When You Want The Finest"

We stock the entire TeleVue line for immediate shipment. — All items also on display and available for purchase and pick up at our showroom.

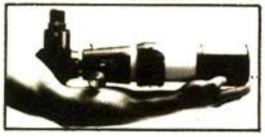
NEW for 1994

Panoptic 15MM and 27MM Eyepieces
In Stock — Tack Sharp 68° Apparent Field!

All Eyepieces and Accessories at Special Sale Prices

Plossls! 7.4, 10.5, 13, 17, 21, 26, 32, 40, 55MM
Widefields: 15, 19, 24, 32 MM
Naglers: 4.8, 7, 9, 12, 13, 16, 20MM
Panoptics: 22, 35MM
Barlows: 1.25", 1.8x, 2.5x 2" 2x Barlow
Paracor: Eats coma in Fast Dobs. 1 1/4 & 2" sizes

Pronto 70MM AP. F6.8, 480MM F.L. Available in 1 1/4" Image Erect, 1 1/4" Star Diagonal and 2" Star Diagonal models.
"The little scope — that could"



Sky Tour has arrived!
Exciting Sale Priced Packages for Genesis and Gibraltar — contact us for exciting details which include Free Eyepieces, Solar Filter and More!!

BINOCULAR SPECIALS

Fujinon FMT SERIES
Ideal for Astronomy

6x30 FMTR-SX	$348.
10x70 FMT-SX	$479.
7x50 FMT-SX	$398.
16x70 FMT-SX	$540.
7x50 FMTR-SX	$459.
Tripod Adptr.	$15.00
8x40 BFL Close Focus w/lock	$229.

We also carry and stock Zeiss, Swarovski, Swift, Nikon, Aus Jena, Pentax, B&L, Steiner, Minolta and Kowa spotting scopes.

SPECIAL PURCHASE

10x30 Adlerblick	$109.

JIM'S MOBILE

We stock the entire JMI line - Call us and save.

Moto-Focus LX3/5/6/200	**$79.00**
Moto-Decs LX3/5/6	**$75.00**

Moto-Focus and Moto-Decs for all scopes avail. Contact us for special sale prices on NGC Mini Max, NGC Max, Micro Max.

New — NFG-2 Deluxe Focuser (used on NGTs) with or without motor focus.

SPECIAL - Eliminate Image Shift with NGF-S Focuser **$269.00**

ACCESSORIES CORNER

T-Rings (spec. camera make)	$10.00
Tele-Extenders & T-Adapters for SCT's	$22.00
Color & Moon Filters 1.25	$12.00
(Set of 6) Color & Moon Filters 1.25	$59.95
Drives for Tasco Eq. Mount	$75.00
Anti-Vibration pads for Tripods	$40.00
Tripod Slo-mo controls	$36.00
New Deluxe Optics Cleaning Kit	$19.00
Celest. F6.3 Reducer/corrector	$118.00
Celest. Photo Deluxe Tripod	$95.00
12 Volt Dew Remover Blower	$11.95
Kwik Focus-Lens Cap 8"	$39.95
Kwik Focus-Lens Cap 10" & 11"	$44.95
Red LED Chartmaster flashlight	$17.50

THOUSAND OAKS SOLAR FILTERS

— The Best —
See actual sunspots safely with your telescope

Type I 8"	$88.00	Type II 8"	$115.00
Type I 10"	$98.00	Type II 10"	$128.00

ALL sizes available for all scopes.
Type III and new thread ins avail.

NEW SOLAR PROMINENCE FILTERS

See solar prominences with your refractor or Cassegrain with new Thousand Oaks Optics Solar Prominence Packages. Contact us for introductory specials.

ALL LUMICON FILTERS IN STOCK

We carry D&G Refractors;
Tech 2000 Dob Drives
We are an authorized Parks Dealer.
Contact us for Daystar-T-Scanners
University Optics Dealer

NEW — VIEWING CHAIR $149.00

NEW LOSMANDY GM-8 with Polar Finder and Dual PEC Drive, ideal for refractors and 8"SCT's. $1349.00

A Pocono Mt. Optics Exclusive
We Are An Authorized Losmandy Dealer

SPECTRA ACCESSORIES SOLVE FOCUS PROBLEMS FOREVER

with Spectra's Sure-Sharp Optical Grid Focusing method for perfectly focused astrophotos

Sure-Sharp	$135.00
Point Source	$59.00
Rt. Angle viewer	$49.00
Duo-View	$79.00

Spectra Guide/Deluxe Radial Model — Call

Introducing the new Ascension Drift Corrector, by Electronic Services. This unit corrects the error in your current drive corrector. Realize up to 90% improvement.
Intro Special $159.95

EDMUND SCIENTIFIC

Astro Scan 2001
World Famous 4 1/4" Portable Reflector Scope
$298.00

ASTRO SCAN ACCESSORIES

New Tripod for Astro Scan	**$87.00**
Tripod Bkt ......$41.95 Tote Bag	**$29.95**
Var. Cam. Ad	**$67.95**
Sun Viewing Screen	**$45.95**
St. Thru Image Erector	**$59.00**

EYEPIECES & ACCESSORIES

1 1/4" RKE 8, 12, 15, 21 or 28MM	**$41.95**
RKE 2.5x Barlow	**$64.95**

Edmund, Orthos, Kellners, Ortho ZOOM
Sale priced.
ALL EDMUND PRODUCTS AVAILABLE

Tectron Collimators improve Newtonian images w/the following:

Sight Tube	$29.00
Cheshire Eyep.	$38.00
Auto-collimator	$31.00
Above 3 w/Bklt.	$95.00
New "Revised" Booklet on Collimation	$6.00

For that Fast New Scope You're building or for upgrading your current scope —

New — The Modern Dobsonian Booklet	$11.00
Ultra Low Rack & Pinion Focuser 2" w/1 1/4" Adptr.	**$125.00**
Photographic Focuser	$159.00

QUARTZ DRIVE CORRECTORS BY VOGEL — All Digitrak II

SINGLE AXIS

VE-200 Runs off DC	$132.95
VE-300 Runs off DC/AC	$159.95
VE-400 Runs off DC/AC or Int. Battery	$198.95

DUAL AXIS

VE-200 D	$174.95
VE-300 D	$212.95
VE-400 D	$262.95
VE-100 Inverter (converts your motor to DC)	$71.95
Interface Cable for SBIG-4	$17.95

NEW VE MINI TRAK

State-of-the-art, variable speed drive corrector, power inverter. Includes digital quartz tracking indicator — Easily hand held.
Complete with D.C. cord.
Sale Price $84.95

Now Available
The Kendrick Dew Remover System
For all size scopes, finders, mirrors

COMPUTER SOFTWARE

Dance of the Planets with companion Sale Price $125

Dance of the Planets with companion and extensions Sale Price $155

"THE SKY"
Levels 2 & 3 avail. DOS or WINDOWS computer/scope interface kits in stock - CD ROM Level 3 and GSC avail.

SkyPro software now available.

STARGAZE	$79.00
EZ COSMOS for Windows	$49.00
New RED SHIFT CD ROM for Windows & Mac	$60.00

TELRAD w/Base

$39.00
Batteries included!

Hinged Deluxe Dew Caps	**$10.00**
Extra Bases	**$7.95**
Extra Reticles	**$2.95**
Pulsar Unit	**$19.95**

CELESTRON

New Celestron Ultima 2000 8" and SCT's have arrived.
Contact us for details.

We Carry the Full Line of Meade Telescopes & Accessories

New Flexible Dew Shields
8" – $29.00   10" – $39.00

Questar

We are a stocking, authorized Questar Dealer. Please contact us for sale prices before you purchase!

SPECIAL PURCHASE – 3.5" STD, Pyrex w./mag. fluoride and power guide. Factory sealed – Call!

Astro Systems

We carry Astro Systems full line of telescope making equipment, Primary Mirror Cells, Secondary Holders, Heavy-Duty Spiders, Teflon Bearing Kits.

Announcing Enhanced Coated Secondary Mirrors — Intro. Prices
1.3" — $38   1.5" — $42   1.8" — $48
2.1" — $58   2.6" — $68   3.1 — $99
3.5" — $199   4.0" — $249

12 AMP HR. Heavy Duty PORTA-PAC $86.95

PORTA-PAC. $65.00

BEATTIE INTENSCREEN-PLUS

Ultra bright focus screens for:

Olympus OM-1, 2, 3, 4	$62.00
Nikon F, F2, F3	$93.95
Nikon FE, FE2, FM2, FA	$62.00

EYEPIECE SPECIALS!!

Buy Direct and Save

Coated and threaded for filters:

1 1/4" Kellners 6, 9, 12, 18, 25MM	$29.95
1 1/4" Orthos 4, 5MM	$46.95
1 1/4" Orthos 6, 7, 9, 12.5, 18, 25MM	$44.95

1 1/4" ERFLES

16.MM	$58.00	25.MM	$62.00
20.MM	$60.00	32.MM	$70.00
2" Erfle 32MM	**$125**	1 1/4" 2x Barlow	$39.00
1 1/4" 8.4-21 ZOOM			$85.00

Vixen LV Eyepieces in stock from $94.00

BOOKS & STAR CHARTS

MAG 5 Star Atlas	$6.50	MAG 6 Star Atlas	$16.95
Sky Atlas 2000 Field or Desk			$19.95
Sky Atlas 2000 Color			$40.00
Laminated Deluxe 2000 Color			$84.95
Laminated 2000 Field or Desk			$58.95
Burnham's Handbook — All 3 Volumes			$35.95
Norton's Sky Atlas			$38.95
Uranometria Vol. I or II			$39.95
Astrophotography for the Amateur			$18.00
Astrophotography by Gordon			$18.00
Astrophotography II by Martinez			$18.00
Backyard Astronomers Guide			$39.00
Atlas of the Moon by Rukl			$27.95
Deep Sky Field Guide to Uranometria			$49.95
All About Telescopes by Edmund Scientific			$13.95
How to Choose Binoculars by A. Hale			$5.00
1000 +			$33.00
Atlas of Deep Sky Splendors			$39.00
New CCD Cookbook			$28.00

No surcharge on credit cards

P. List send SASE w/58¢ in stamps

POCONO MOUNTAIN OPTICS **— North Pocono Village Shopping Center**
RR 6, Box 6329, Moscow, PA 18444

Catalog: $6.00 (within U.S.)
$9.00 to Canada
$15.00 Elsewhere

Showroom Hours, 10 am-5 pm Monday thru Saturday
We purchase and take in trade used telescopes

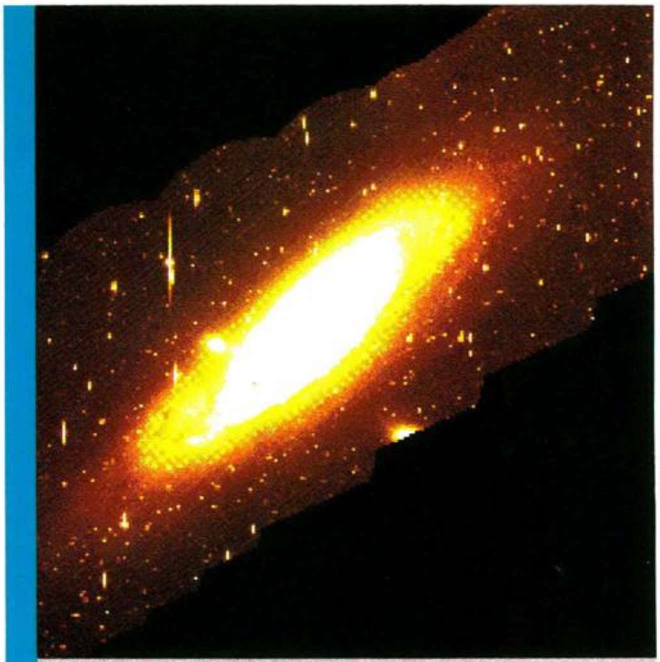
$5.00 MINIMUM SHIPPING — U.P.S. (IN U.S.)
Speak with amateur astronomers . . . ASK FOR GLENN — ARS: K3WEI, DON KD3LN or MIKE

ORDERS - TOLL FREE — 800-569-4323 till 9 P.M. 7 days a week   (info) **717-842-1500** till 9 P.M.   FAX (24 hours) **717-842-1408**   **WORLDWIDE SHIPPING**

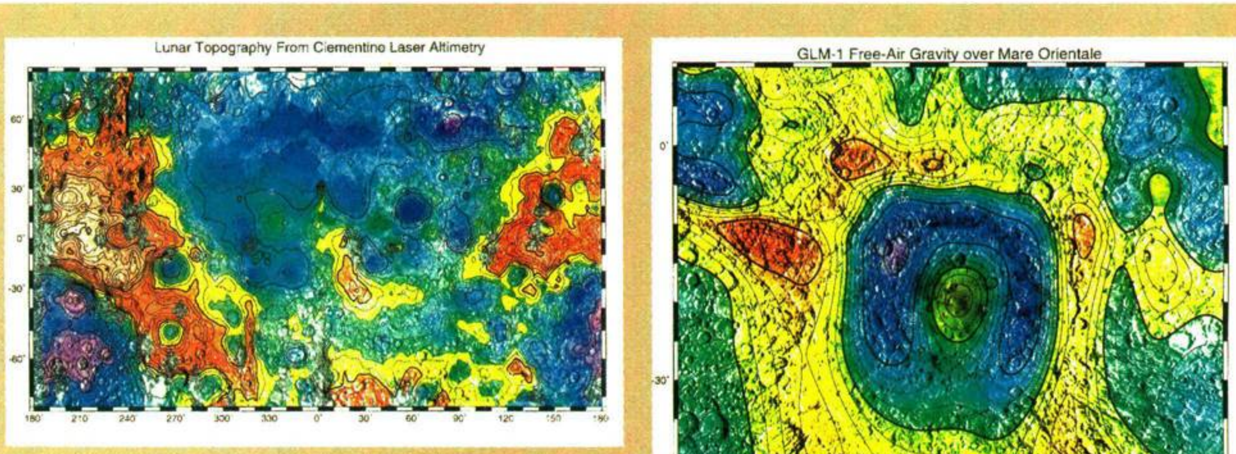
Mars Once Have Martians?" September 1993.) To test this idea, Farmer's proposing that NASA mount a mission later this decade to search for fossilized remains of past Martian life. With colleagues at Arizona State University, he is currently compiling a catalog of promising sites, to be published by NASA later this year.

PARIS, France — The European Space Agency has announced it is conducting a global search for experimenters to use INTEGRAL, ESA's International Gamma-Ray Astrophysics Observatory, slated for launch in 2001. The spacecraft's primary mission will be to map and investigate the nature of gamma-ray sources, ranging from neutron stars to the centers of active galaxies. After sifting through experiment proposals in early 1995, the planners will then select principal investigators and enter an engineering design phase. ESA will fabricate the craft, NASA will provide for the use of one or possibly two ground stations, while Russia is expected to contribute a Proton rocket for launching.

LAUREL, Maryland — In keeping with the "smaller and cheaper" theme borne out by the Pentagon's Clementine mission, the International Academy of Sciences recently sponsored a three-day conference on low-cost planetary missions. The proposals explored by mission planners were: sample returns from comets and asteroids; flybys of 2060 Chiron, Uranus, Neptune, and Pluto; a Mercury orbiter; a Venus multi-probe mission; and "sounder" spacecraft to study the Sun's corona. All missions would take advantage of miniaturized components, launch on inexpensive boosters, and have relatively fast development times. Many of these ideas might come to fruition through NASA's "Discovery" program, which requires that missions go from concept to launch in 36 months and cost less than $150 million.



ANDROMEDA'S M31 GLOWS in this near-infrared image obtained by astronomers with the Harvard-Smithsonian Center for Astrophysics, Space Telescope Science Institute, and Princeton University Observatory. The view was electronically combined from 41 individual snapshots with a resolution of two arcseconds. The Milky Way's stars have been digitally removed, allowing for a detailed study of stellar distribution in the Andromeda Galaxy.


Lunar Topography From Clementine Laser Altimetry
60°
30°
0°
-30°
-60°
180°
210°
240°
270°
300°
330°
0°
30°
60°
90°
120°
150°
180°
GLM-1 Free-Air Gravity over Mare Orientale
0°
-30°

Maria Zuber (Johns Hopkins University), et al.

CLEMENTINE MAPPED THE MOON in unprecedented detail, revealing its overall topography for the first time. The laser altimetry map (**left**) shows lunar heights and depths from latitude 70° north to 70° south. High areas are shown in red and brown while low areas are in blue and purple. The hemisphere visible from Earth stretches from longitude 270° on the left to 90° on the right (longitude is the horizontal scale). Note the large, deep depression at lower left, the South Pole-Aitken basin. Clementine confirmed this as the largest impact basin known in the solar system, stretching over 2,500 kilometers in diameter and reaching a depth of over 12 km.

The spacecraft also measured the gravitational pull of the Moon. Maps of these data show that dense material, presumably from the Moon's mantle, has been uplifted beneath many of the Moon's impact basins. A particularly striking example is Mare Orientale (**right**), the youngest impact basin on the Moon (located at about longitude 270° and latitude –20°).

X-FILES ONLINE.
THE TRUTH IS HERE, X-PHILES. DELPHI. INTERNET CENTRAL FOR THE X-FILES.

X
THE X FILES

CHAT WITH THE X-FILES' PRODUCERS ONLY ON DELPHI.

Watch The X-Files on FBC, then meet the creative team behind the show. Chat with Creator/Executive Producer, Chris Carter, and writers/producers Glen Morgan and James Wong. Send and receive e-mail. Attend live online conferences. Not only is Delphi the cheapest, widest and best supported access to the Internet, it's also the only online service to offer:

- Official X-Files t-shirts, hats, keychains, mugs and sweatshirts.
- A database of official downloadable X-Files photos, video, sound track and program synopses.
- Direct access to related Internet Usenet groups from the X-Files Forum.

Five hours FREE on Delphi Internet

For immediate access from any computer, dial by modem 1-800-365-4636, press return until you get a prompt. At password, enter ASTC94

DELPHI
INTERNET

20th TELEVISION

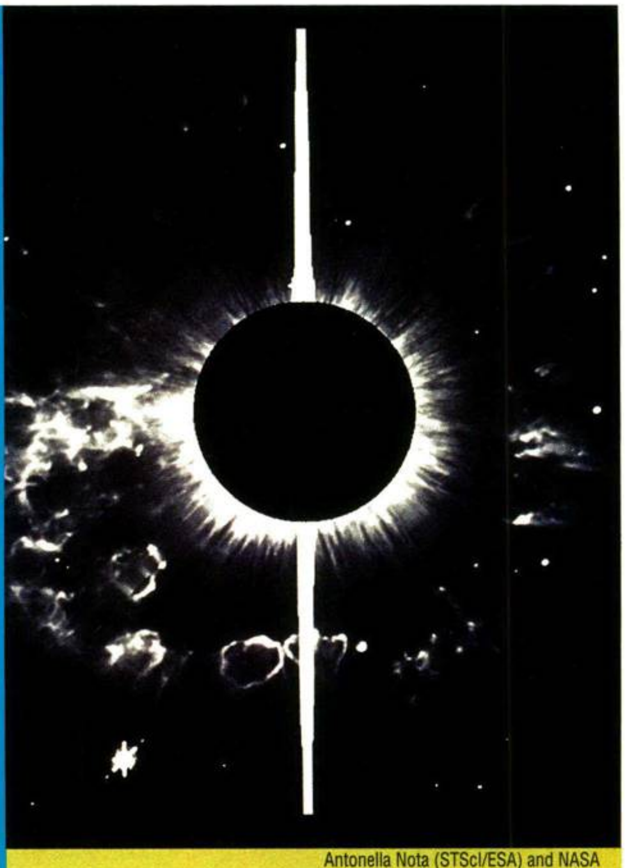
Offer applies to new members only. Valid credit card required for immediate access; other restrictions apply-details provided during registration. Questions? Call 1-800-695-4005 (voice). Send e-mail to INFO@delphi.com. ™ & © 1994 Twentieth Century Fox Film Corp. All rights reserved.

Stellar Mystery Solved

When astronomers discovered main sequence stars rich in carbon, they were puzzled. Main sequence stars can't produce carbon. Recent studies have shown, though, that these red, faint dwarf stars do not produce the carbon; they receive it from a giant-star companion.

Two clues led to this conclusion by Paul Green of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, and Bruce Margon of the University of Washington in Seattle. One was that the stars were also rich in barium and the other that they had strong concentrations of different isotopes of carbon (isotopes of an element contain the same number of protons but differing numbers of neutrons in their nuclei).

These two clues also appear in other stars that are known to have had mass transferred to them. The astronomers suggest in the March 10, 1994 issue of the *Astrophysical Journal* that a dwarf carbon star starts as a normal main sequence star in a binary system. Then the star's companion becomes a giant star and in its bloated state transfers mass to the dwarf, enriching its carbon supply. The giant then becomes a white dwarf. The white dwarf escapes detection by astronomers because it lies far from the dwarf carbon star.



Antonella Nota (STScI/ESA) and NASA

BUBBLES OF DUST surround AG Carinae, a luminous blue variable star that is among the brightest and most massive stars in our Galaxy. The dust had been seen before by ground-based telescopes, but it wasn't resolved and appeared to be a jet. This new image, from HST's Wide Field/Planetary Camera 2, resolves the "jet" into a complex structure of bubbles, arches, and filaments. Dust is highly unusual around stars as hot as AG Car, which has a surface temperature of 30,000 kelvins. Astronomers think the dust may be a relic from the star's previous red supergiant phase that has been pushed away from AG Car by the star's 70 km/sec stellar wind.

Dusty Birth Announcement

Dust surrounding a distant quasar may be the earliest sign yet found of a newborn galaxy, says a team of astronomers from the United Kingdom, France, and Germany. The team was observing the quasar BR 1202 −0727 in Virgo at a radio wavelength of 1 millimeter when their instrument picked up signals from a dust cloud with about 100 million times the mass of the Sun surrounding the quasar.

Astronomers think the dust cloud is part of an unseen larger galaxy whose active core is the quasar. The dust cloud might contain as many as a million million solar masses. Such dust clouds typically are rich stellar "nurseries" where stars form at a rapid pace.

"We may be seeing this quasar and its surrounding galaxy only a few hundred million years after it switched on," says Richard McMahon, a team member at the University of Cambridge. "If so, then the galaxy's light may just now be shining through the dusty cloud that covered it while it was forming."

The quasar has a redshift (z) of 4.69, which places it at a distance of 12 billion lightyears. The signals originated when the universe was about 1 billion years old.

SERENDIP Hopes For Lively Reruns

Because it spreads like an expanding bubble into the cosmos, humankind's electromagnetic clutter could serve as a clarion call to any extraterrestrial civilization listening for proof they're not alone in the Galaxy. If it would work for them, why not us? Hoping that's just the case, a team at the University of California at Berkeley is searching the radio sky for signs of intelligent extraterrestrial life.

Since 1980, Project SERENDIP (Search for Extraterrestrial Radio Emissions from Nearby Developed Intelligent Populations) has spent 3,600 hours scanning and recording more than 110 million radio signals between 424 and 436 megahertz, frequencies most commonly found in UHF-TV, radar, and other communication channels. Radio signals in this band continually escape from Earth, making us detectable to anyone searching for our presence. The Berkeley group is looking for similar signals that may have leaked from planets with technological civilizations much like Earth's.

Scientists conduct SERENDIP's search with instruments piggybacked on other experiments mounted to the 1,000-foot radio telescope at Arecibo, Puerto Rico. Since Arecibo is used around the clock by guest astronomers, SERENDIP is able to operate 24 hours a day, recording and analyzing data. Computer software specially designed for the effort monitors 4 million radio frequencies every 1.7 seconds. Candidate signals are stored for further analysis at Berkeley. Later this year, the project will get its next generation of instruments, capable of analyzing 120 million radio channels simultaneously.

"The hope is that other intelligent civilizations are either leaking radio waves from their own communication," says Dan Werthimer, electrical engineer and program manager of the project, "or sending out a signal on *purpose*, either directly to us, or omni-directionally in an 'Is anyone out there?' kind of signal." — *Cynthia Scanlon*

Reader's Exchange

FOR SALE. Twelve boxes of Astronomy, *Sky & Telescope*, *Omni*, *Scientific American*, *National Geographic*, and other science magazines; Individual issues 50 cents each plus postage. Will take offer for entire set. No trades please. Send issue date and/or number. Contact Jim Carleton, 1948 Milburn St., Camarillo, CA 93010-6305.

FOR SALE. Celestron Super Polaris C8 system. Includes Starbright coatings, SkySensor computer, SP dual-axis drive corrector, shield, and extras; $1,200. Excellent condition. Contact Val Robichaux, 14756 C.R. 21, Cortez, CO 81321, (303) 565-6259.

FOR SALE. SP-C8 counterweights and Meade model 102 1000mm guide scope/telephoto lens (can be piggybacked on C8); $400. Excellent condition. Contact Val Robichaux, 14756 C.R. 21, Cortez, CO 81321, (303) 565-6259.

FOR SALE. Olympus OM-1 35mm camera, Spiratone critical focuser, OM-1 T-ring adapter and shutter release cable, Orion off-axis guider, and Celestron 12.5mm ortho/illum reticle; $400. Contact Val Robichaux, 14756 C.R. 21, Cortez, CO 81321, (303) 565-6259.

FOR SALE. Meade 2080 with field tripod, polar drive, viewfinder, lenses, and a carrying case; $1,750. Contact Barbara Frogge, P.O. Box 524, Lake Junaluska, NC 28745, (704) 456-8119 evenings.

ANNOUNCEMENT. The Society of Amateur Radio Astronomers would be pleased to answer any questions about radio astronomy. Contact Vincent Caracci, Society of Amateur Radio Astronomers, 247 N. Linden Street, Massapequa, NY 11758.

FOR SALE. *Astrophysical Journal* (1960 – 1969); $300. Contact (618) 632-4579.

WANTED. Members for Sunderland Astronomical Society. A wide-range of instruments are available for use. Give us a call for more details. Contact Don Simpson, 78 Stratford Avenment, Grangetown, Sunderland, SR2 8RZ England, 091-567-0151.

WANTED. Hobbyist seeks early model cameras such as Bandoneon, Bayan, Concertina, Violin, Colibri, Leica, Riga or USSR Minox, Robot, Zeiss, Contura, Detrola, Kardon, Ranger, Zephyr, BOOMU, Cnopm, FAG, FED, Gomulka, Pioner, TCBBE, Reid, Alta, Canonhanza, Chiyotax, and many more. Contact Edmund Juszczyk, 2421 West 46th Street, Chicago, IL 60632. ☐

Please submit Reader Exchange notices in writing to Tracy Staedter, Astronomy, P.O. Box 1612, Waukesha, WI 53187-1612, or fax them to (414) 796-1142. Notices will be placed at no charge for non-commercial purposes only. Kalmbach Publishing Co. assumes no responsiblity for statements made nor for the quality of advertised items.

Ideal "first telescope" for your entire family
Astroscan® 2001 WIDE-FIELD Telescope

Edmund's World Famous Astroscan® Telescope. The easiest to use and enjoy family telescope. #AV2001 $399

The Stargazers Choice

Reach out and explore the night sky. Unique award winning design allows you to cradle it in your arms or it glides smoothly and solidly into its table-top base. Highlights of this scope are its extra wide 3° field and its superb light-gathering ability with large 4 1/8" clear aperture to resolve panoramic vistas. Optional image erector adapts scope to view land objects. Focuses 25 feet to infinity. System is sealed to protect against dust and moisture and is permanently collimated at the factory.

Astroscan 2001: Includes telescope, base, 28mm RKE® eyepiece, finder sight, dust cap, carry strap, 36 page instruction book and our 36 page sky guide. A wide assortment of accessories are also available.

Order direct. For phone orders call 1-609-547-8880, all major credit cards accepted. Call 24 hours a day. 45 day unconditional guarantee or money refunded in full.

New! Astroscan Telescope Tripod

THE EDMUND RKE® BREAKTHROUGH...A NEW STANDARD IN EYEPIECE PERFORMANCE...AT A PRICE YOU CAN AFFORD.

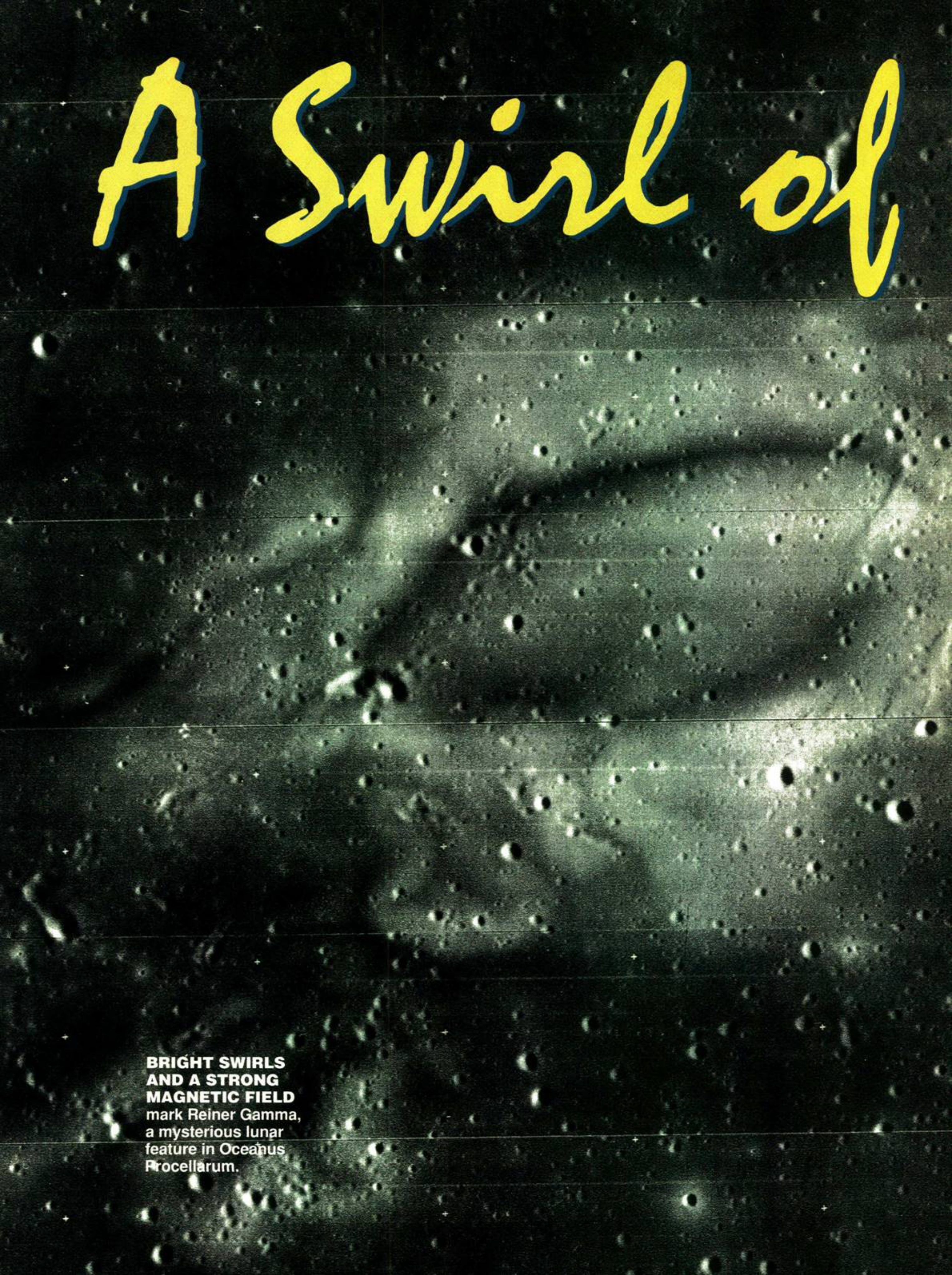
Our moderately priced, three-element system outperforms designs using four or more optical elements. The exclusive design of the RKE® eyepiece family coupled with the quality of its optics admits more light, is free from false color and offers a sharply-focused, wide-field view.

8mm #AV30,820
12mm #AV30,940
15mm #AV30,819
21mm #AV30,941
28mm #AV30,787
(specify) $49.95 Ea.

SEND FOR FREE CATALOG
Includes a wide selection of telescope components in stock for immediate delivery for the avid astronomy enthusiast interested in building telescopes.
CALL 1-609-547-8880

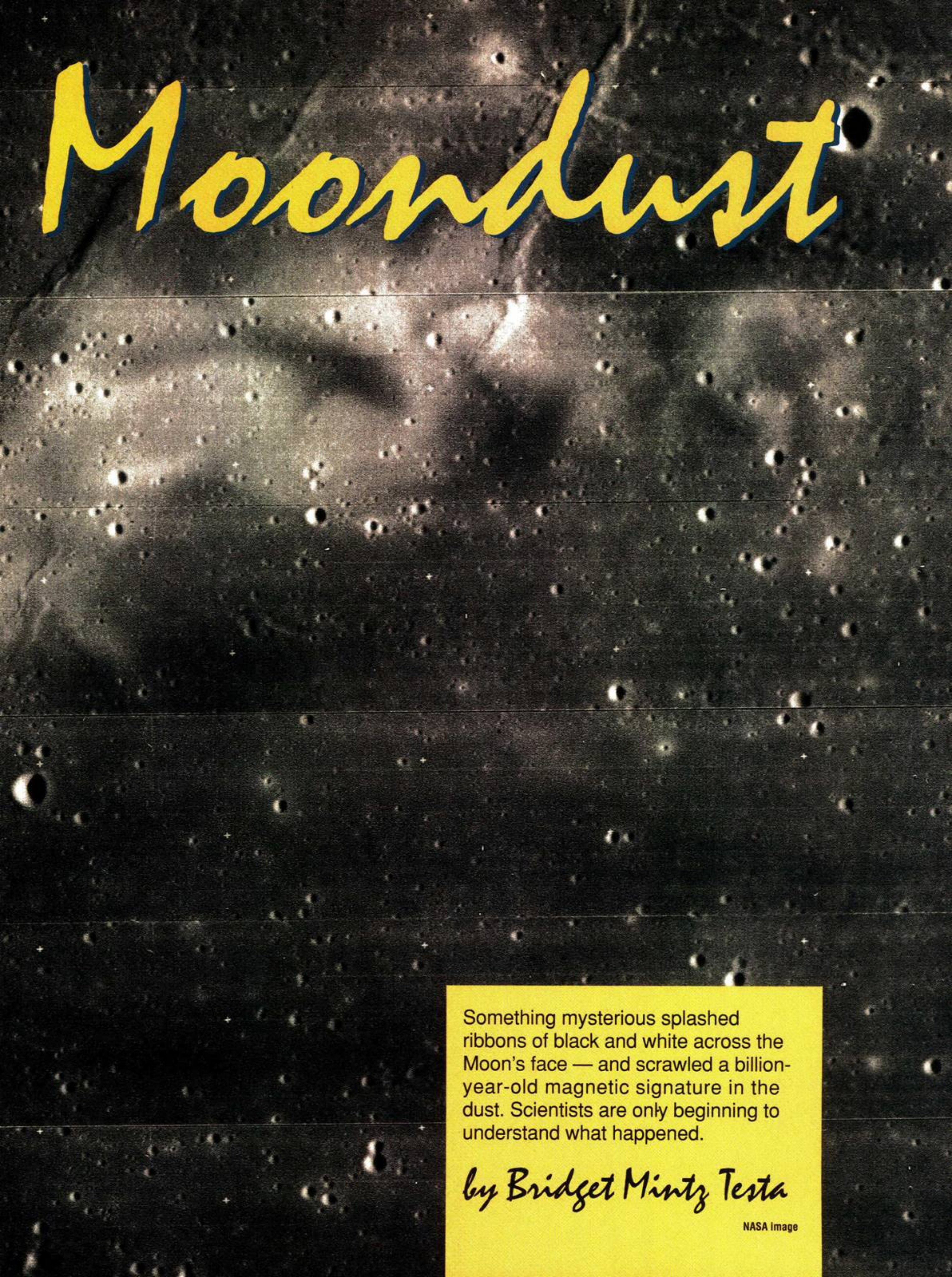
America's First Optical Catalog • Since 1942
Edmund Scientific Co.
Dept. 14LA, C921 Edscorp Bldg., Barrington, NJ 08007

A Swirl of



BRIGHT SWIRLS AND A STRONG MAGNETIC FIELD mark Reiner Gamma, a mysterious lunar feature in Oceanus Procellarum.

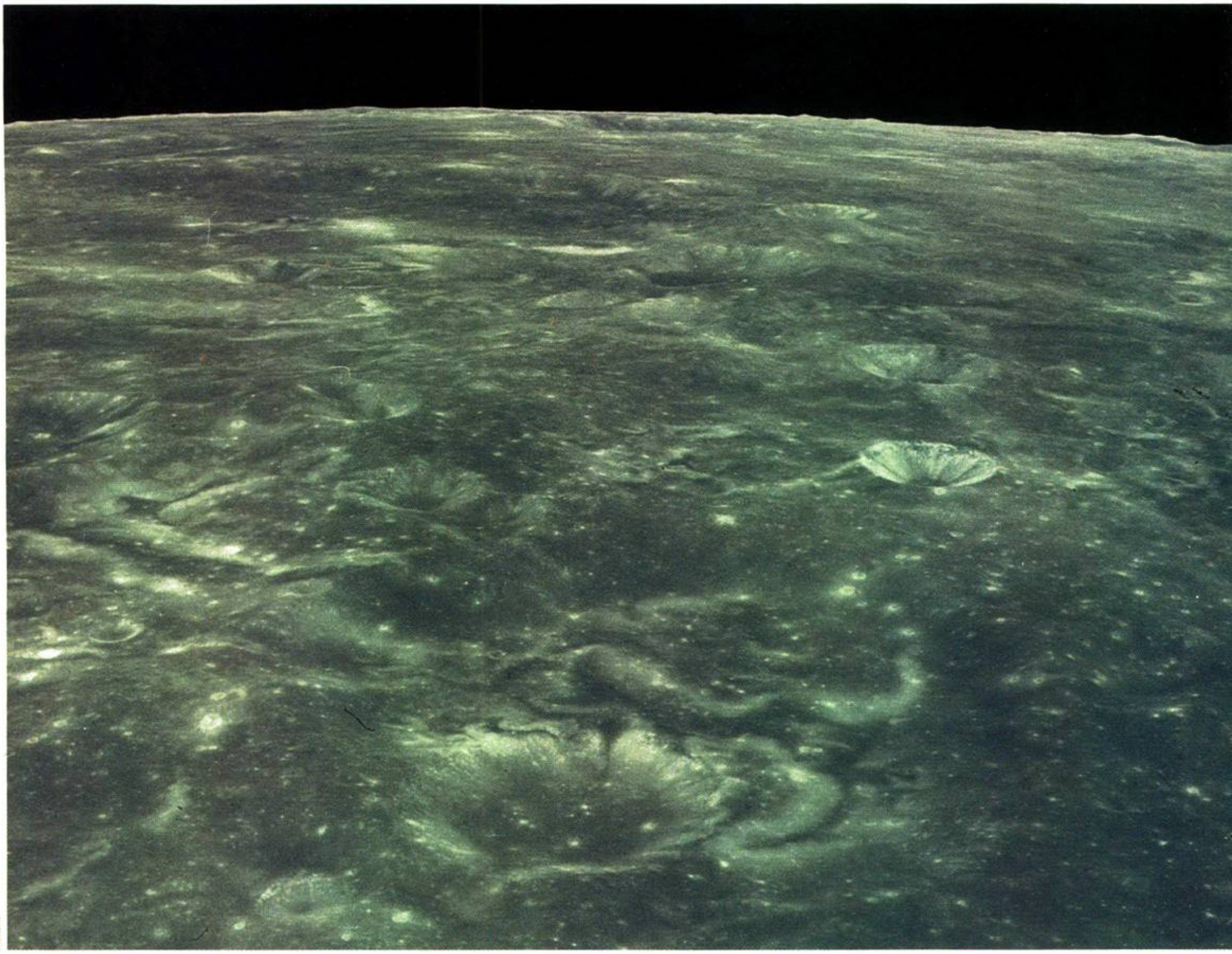
Moondust



Something mysterious splashed ribbons of black and white across the Moon's face — and scrawled a billion-year-old magnetic signature in the dust. Scientists are only beginning to understand what happened.

by Bridget Mintz Testa

NASA image



NASA

Some look like a brilliant white snowfall that outlines black crevasses and fissures. Others resemble a frosting of snow draped on a dark terrain that peeks through as bands of black. Intensely magnetized and found in only a few special places on the Moon, these bands of light and dark are the lunar swirls — and for the past 25 years they have been one of the Moon's most tantalizing and frustrating enigmas. Planetary scientists still don't know what caused them.

When Apollo 11 returned the first lunar samples in 1969, the discovery of an ancient magnetism in the rocks shocked planetary geologists because earlier lunar probes had found no global magnetic field on the Moon. But scientists reacted swiftly. When Apollos 15 and 16 were launched two years later, each carried a small subsatellite designed to seek the delicate signature of lunar magnetic fields from orbit around the Moon.

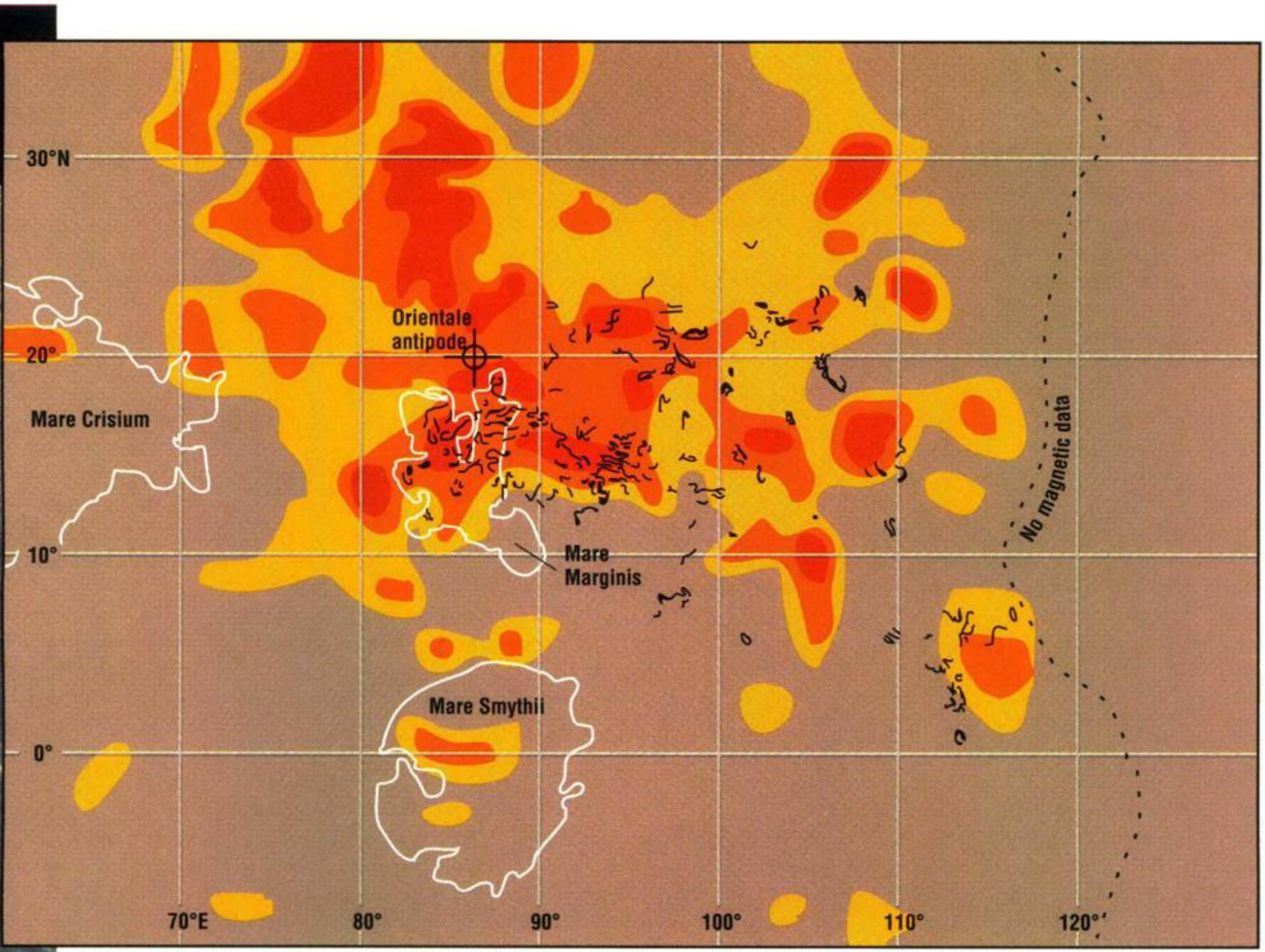
Although the subsatellites were confined to narrow equatorial paths, they found a sprinkling of magnetic fields here and there on the Moon. Unlike Earth's global magnetic field, which is uniform in strength, the field strengths of lunar regions ranged between 10 times and $^1/_{1000}$ that of Earth. Lon Hood, now a physicist at the University of Arizona, participated in the work of trying to track down the magnetic mystery.

"After mapping the overall field," he recalls, "we noted that two very large regions had much stronger magnetic fields. These were located almost diametrically opposite the Imbrium and the Orientale basins. Further mapping showed that there was an additional pair of field concentrations opposite the Serenitatis and the Crisium basins. These four weren't just any basins, though; they were the youngest large impact basins on the Moon."

While scientists digested this, another mystery emerged. One magnetic anomaly coincided with a well-known, if little-understood, visual feature, the Reiner Gamma formation in western Oceanus Procellarum. Measuring 30 by 60 kilometers, Reiner Gamma consists of an elongated patch of bright ground in a swirly pattern (see pages 26-27). It lies about 400 km due west of the crater Kepler and is easily visible in a backyard telescope. It is also apparently unique on the lunar nearside.

"We found a magnetic anomaly directly associated with Reiner Gamma," says Hood, "and that's what caused us to first realize that swirls had something to do with magnetic fields."

Hood and others then began to look for swirls in the areas with strong magnetic fields — the regions which lie opposite or "antipodal" to the Imbrium, Orientale,



ASTRONOMY: Phil Kirchmeier after L. Hood

ENIGMATIC SWIRLS CLUSTER east of the crater Fleming at 110° east, 15° north. The map plots where the swirls lie relative to the Orientale basin antipode; tints show magnetic field strengths surveyed during Apollo.

Serenitatis, and Crisium basins. They found swirls all right — by the hundreds, in fact — and the questions erupted. The first, of course, was What could swirls, magnetic fields, and the antipodes of great impact basins have to do with one other?

According to Hood, the massive impacts that blasted out the big basins on the Moon 3.6 to 4.0 billion years ago are the likeliest culprits. He says two mechanisms could explain the creation of antipodal magnetic fields.

One is the release and concentration of metallic iron (the source of most lunar magnetism) by violent fracturing of terrain on the opposite side of the Moon from a large impact. The antipodal point would become a bull's-eye for seismic waves racing away from the impact as they penetrated the entire Moon. If this idea is correct then the terrain at the impact antipodes should look as though it had been smashed and shaken.

"In the antipodal regions," notes Hood, "you see seismically modified terrain that's very unusual. It looks like it's been jostled and twisted a little bit and maybe almost liquefied temporarily. That terrain is now viewed as being caused by the focusing of seismic waves opposite to the impact point."

Antipodal magnetic fields could also come from any magnetic fields existing on the lunar surface at the time of impact. Here's how it might work. Besides causing seismic disturbances, any large impact would also vaporize massive quantities of rock, producing a huge cloud of partially ionized gas. As this electrically conductive gas expands around the Moon, it would pick up and carry existing magnetic fields with it.

"But on the opposite side of the Moon," says Hood, "all of this impact gas converges. That brings the magnetic fields together and you get a concentration of them on the opposite side of the Moon from the impact point."

But what could be the source of those pre-existing magnetic fields? According to Hood, concentrated deposits of iron grains is one possibility. A second, which Hood prefers, involves some force sweeping the tiny field of the solar wind around the lunar globe, magnifying its strength substantially (see page 30). Another source could be transient magnetic fields caused by the impact itself, which have been found in laboratory experiments involving extremely high speed impacts. A fourth possibility is a dynamo, in which a lunar core of molten metal generates a system of global magnetic field lines through large-scale fluid motion.

Either solar wind or transient fields could account for the magnetism effects. But what about the swirls? According to Hood, magnetic fields generated by the impacts may have created the swirls indirectly.

"The idea is that if you have a region on the Moon with a strong enough magnetic field, it will deflect the solar wind." The solar wind is loaded with solar hydrogen, which is thought to darken the Moon's surface by chemically reducing iron oxides to free iron. However, if the solar wind was deflected by a magnetic field, the lunar surface would not darken. It would remain bright, just like the bright ribbons of the swirls.

As for the dark ribbons, Hood says, "I did some calculations that indicate magnetic fields will both concentrate the solar wind and decrease it in different areas, depending on how the magnetic field is configured." That is, if two magnetized strips border a non-magnetized band, the magnetized strips would push the solar wind away from themselves into the non-magnetic band. The result, according to Hood, could be the bright and dark ribbons of lunar swirls.

Solar wind darkening and basin impacts offer one possible explanation of the enigma of the swirls. Another theory, however, practically turns these explanations upside down. Peter Schultz, a planetary scientist at Brown University in Providence, Rhode Island, believes the swirls are not only not antipodal to the basins, but also associated only indirectly with neighboring magnetic fields. The key, according to Schultz, is age.

"The intriguing thing about these swirls," says Schultz, "is that they have to be quite young — anywhere between 20 and 50 million years old." But if the swirls were created by the basin impacts, then they must have the same age as the basins, 3.6 to 4.0 billion years. Schultz thinks the swirls are younger, however, because otherwise they would have been destroyed by the constant "gardening" of the Moon's surface by meteoritic impacts.

He cites an example. "There are two craters near the Apollo 16 landing site, North Ray and South Ray. One is about 25 million years old and has lost all of its bright ray pattern. The other is about 2 million years old and still has bright rays.

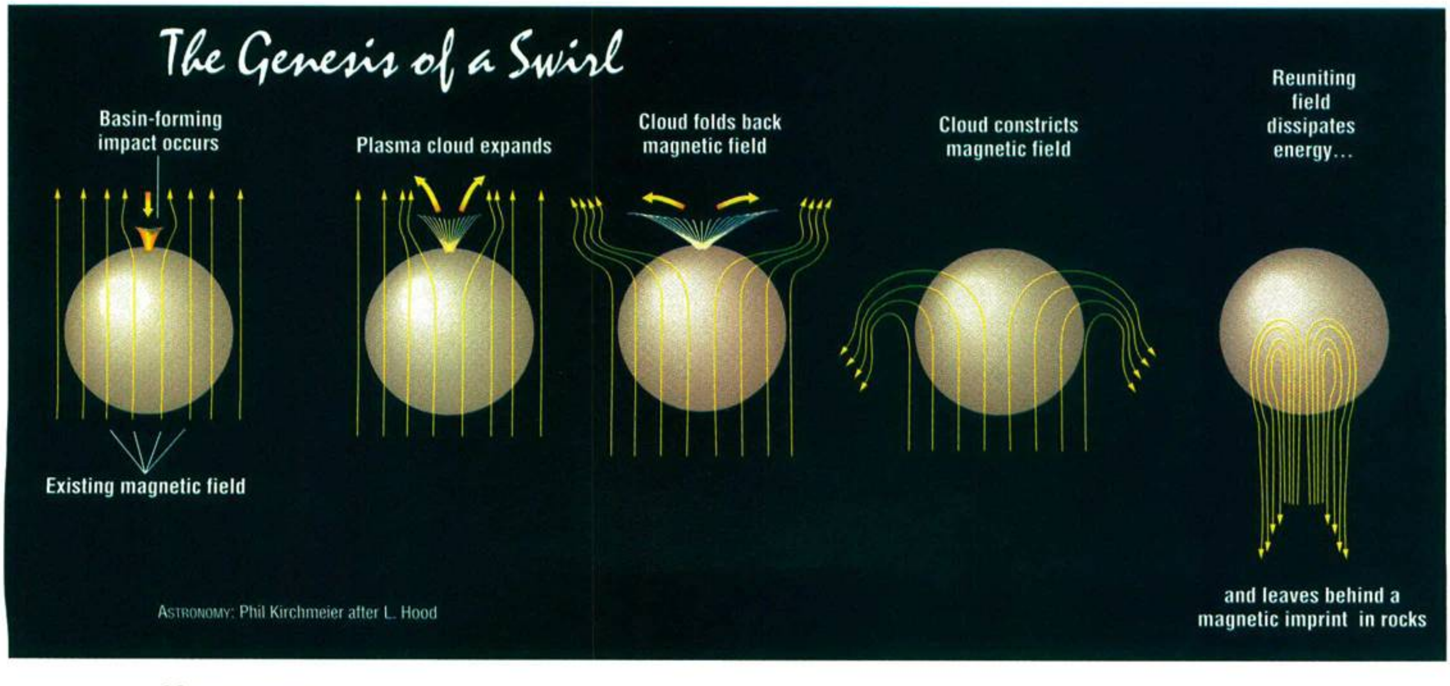
"Now that tells me right there that if you have a bright surface, it's going to be destroyed very quickly because of the role of meteoritic material. That was why we felt so strongly that these things had to be young. The swirls can't be a remnant of something ancient, because if they were, they would never be able to maintain their bright appearance."

What recent event could have created them? Schultz says, "I believe that relatively recently — and we're talking about the last 20 million years or so — a comet collided with the Moon." This comet would have had an atmosphere — its coma — created by the emission of gases as it neared the Sun. The comet would also have produced ionized gases that would trap the solar wind and produce a magnetic field. As the comet neared the Moon, the coma's dust and gas would begin to strike the surface at extremely high velocities, scouring the surface. Schultz believes this scouring created the swirls.

"We estimated that it's comparable to what the lunar landing site was like when the lunar models landed," Schultz says. "The gases coming from the engine prior to landing compressed and scoured the upper surface. When that happened, it created the same type of effect. It made the lunar surface look brighter." As the coma's dust and gas struck and scoured the lunar surface, the magnetic field that the comet captured from the solar wind smashed into the surface too.

"When that happens," explains Schultz, "the magnetic field begins to compress. That compression enhances the field's intensity tremendously." The compressed magnetic field and the coma's dust and gas collide with the surface at extremely high velocities, melting a small zone of the lunar surface. As Schultz sees it, when the melting occurs, it concentrates iron particles. These, being conductive, trap the magnetic field of the comet, resulting in the anomalously magnetized regions seen today. The regions won't necessarily match the swirls, because iron particle concentrations don't happen everywhere on the Moon.

A problem with both Schultz's and Hood's explanations is that neither directly accounts for the ancient magnetism found in Apollo moonrocks that started all the investigations. Schultz's comet would have struck far too recently to have imparted the multi-billion-year-old remnant magnetism. And Hood's basin impacts ended about 3.6 billion years ago, which is also not quite the right time to impart the remnant fields. As Paul Spudis, a scientist at the Lunar and Planetary Institute in Houston,


The Genesis of a Swirl
Basin-forming impact occurs
Existing magnetic field
Plasma cloud expands
Cloud folds back magnetic field
Cloud constricts magnetic field
Reuniting field dissipates energy...
and leaves behind a magnetic imprint in rocks

ASTRONOMY: Phil Kirchmeier after L. Hood

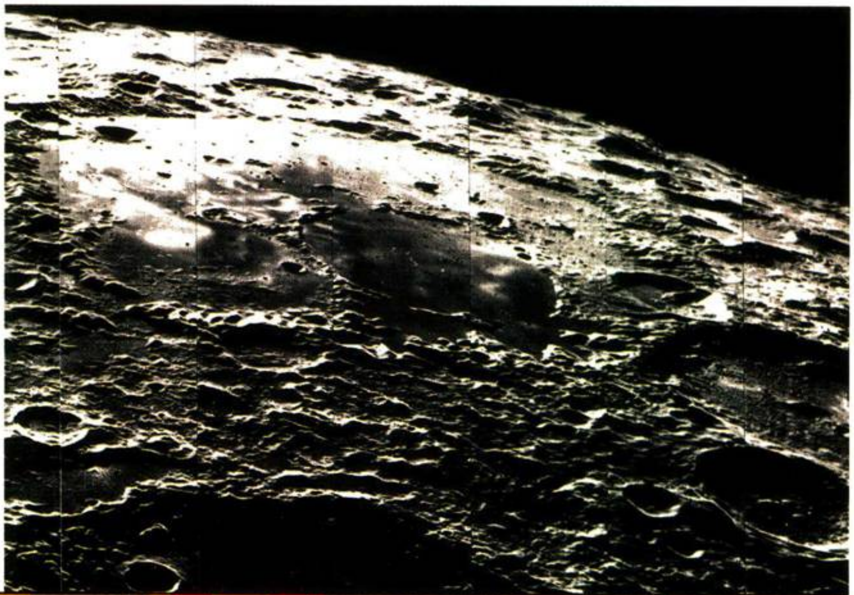
Texas, explains, the lunar samples' remnant magnetic fields vary. In fact, some samples have almost none at all, while some have very strong fields. The strongest fields are often (though not always) found in rocks about 3.5 to 3.6 billion years ago. But Hood's swirl-generating basin impacts ended just about the time the most powerful magnetic fields apparently commenced.

Spudis says, "The magnetic history of the Moon inferred from the Apollo sample collection varies. It calls for no magnetic field early in lunar history, a fairly strong field during the time of mare extrusion (when lava flooded the lunar seas, up to about three billion years ago), and then no magnetic field again in the latter part of lunar history.

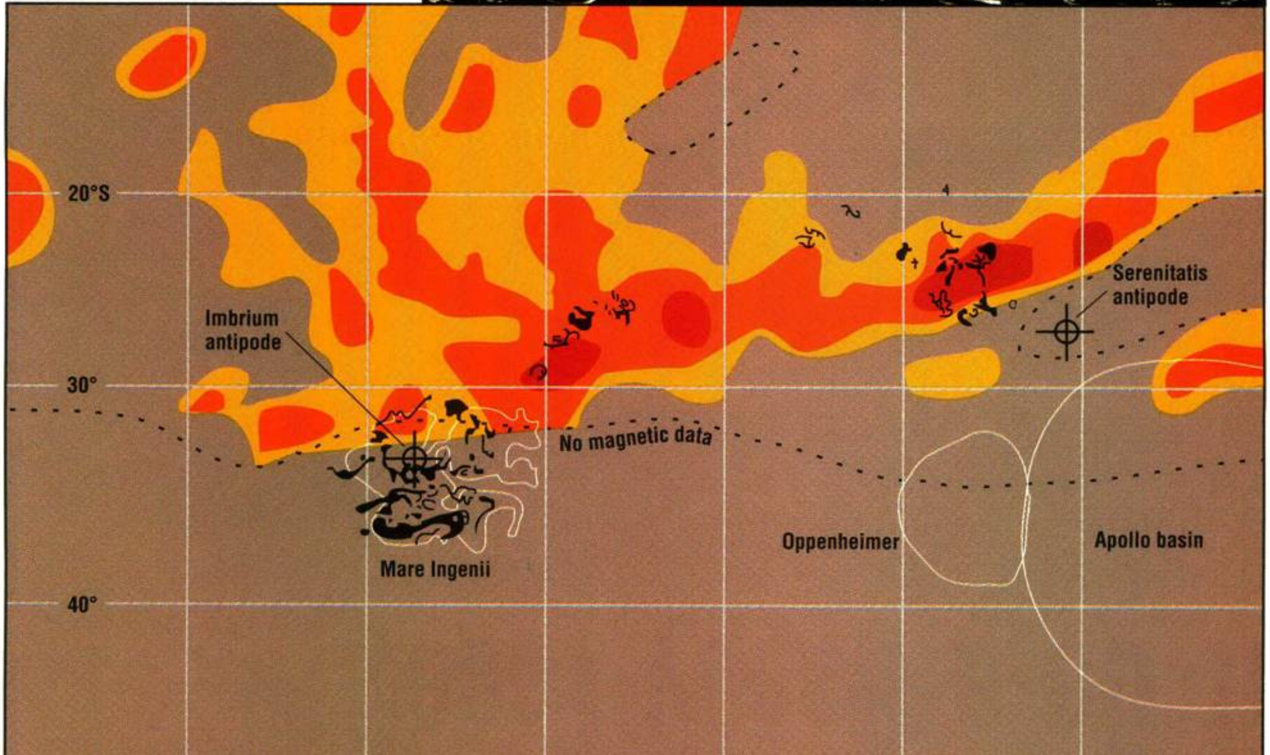
"There are several problems with this. But the biggest is that it's extremely hard to understand in terms of any kind of known geophysical model."

The best geophysical model of a planetary magnetic field is a dynamo. A lunar dynamo, if it happened, would solve a host of mysteries besides the swirl enigma. The only problem is that geologists can't see how a dynamo could ever have existed. According to Spudis, the Moon's 400-km-diameter core is much too small to have generated the kind of large-scale fluid motions thought to make a dynamo operate. And if a dynamo did exist, it inexplicably shut off about 3.5 billion years ago.

Calling for a dynamo that works unlike any other isn't the only problem the swirls pose. Other questions loom. Are all the swirls truly made of the same stuff, or

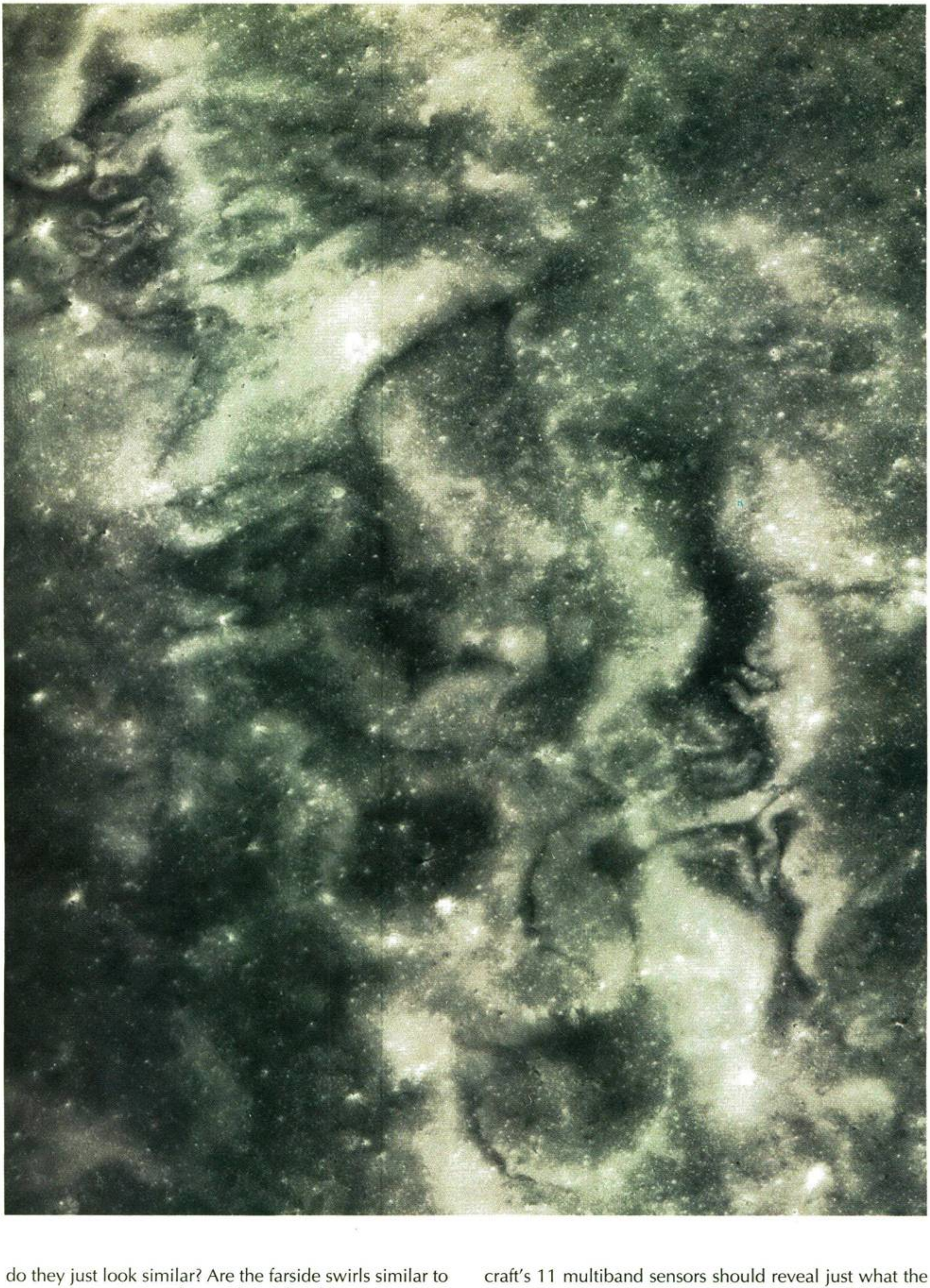


NASA/Lunar Orbiter V



Phil Kirchmeier after L. Hood

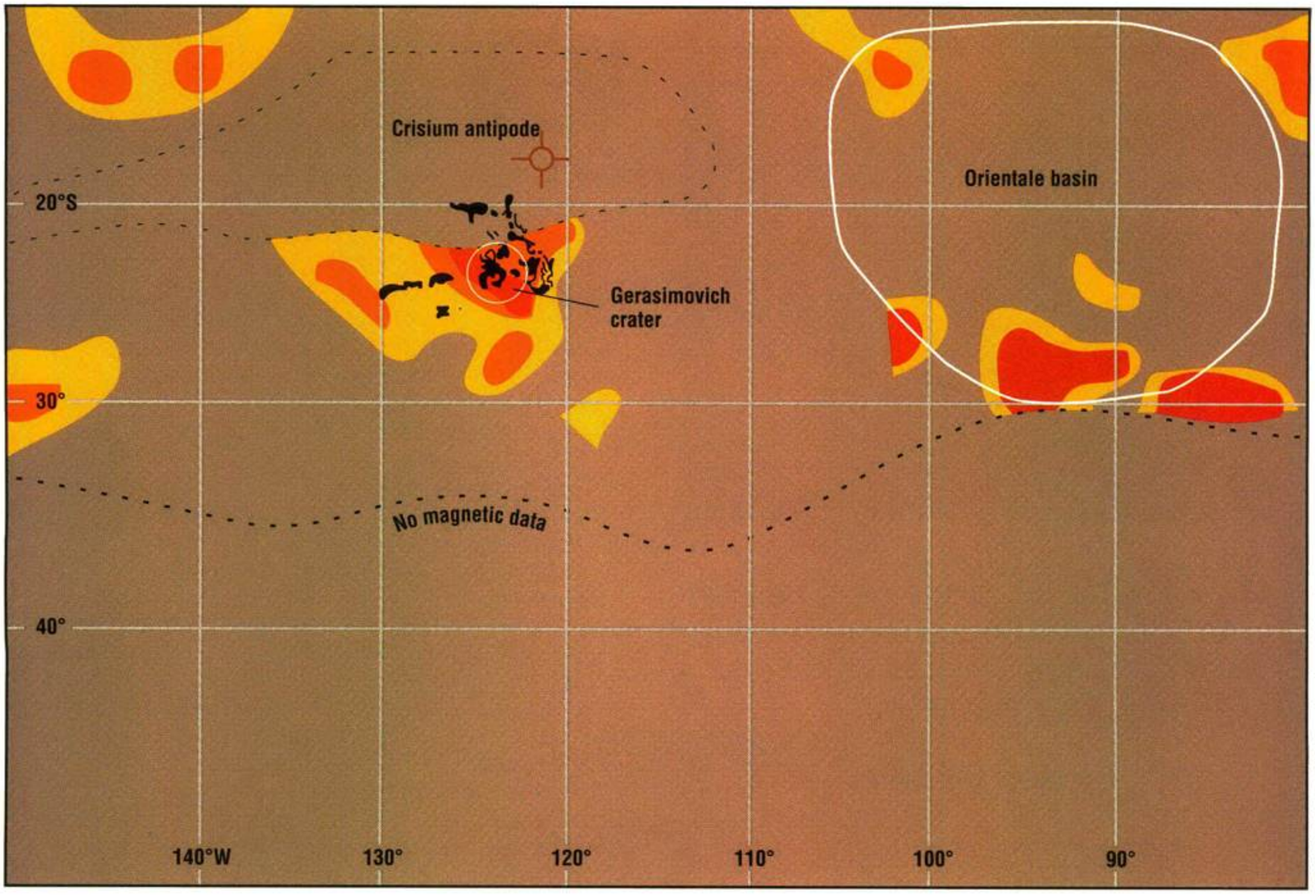
SWIRLS IN MARE INGENII (center) lie almost exactly opposite the Imbrium basin, although scientists do not know what caused them. The map below shows where these swirls lie relative to two nearside basin antipodes and magnetic field disturbances.



NASA

do they just look similar? Are the farside swirls similar to Reiner Gamma? Are the swirls made of local materials, or are they exotic deposits blown in by some catastrophe? And, lastly, do the magnetic fields and the swirls match up precisely?

The results from the recent Clementine mission could shed some light on a few of these. The spacecraft's 11 multiband sensors should reveal just what the swirls are made of. If the swirls are all made of the same stuff and it differs from surrounding terrain, that's an indication that some foreign body like a comet might be their source — maybe. On the other hand, if Clementine shows the swirls' make-up matches the local terrain, that could indicate the swirls were all formed



ASTRONOMY: Phil Kirchmeier after L. Hood

A "SWIRL FARM" NEAR LOBACHEVSKII crater displays the intricate patterns that mystify planetary scientists. Also on the farside, but much farther to the east, magnetic field disturbances and a swirl cluster near the Crisium basin antipode (above).

in situ by a single process, like seismic shaking from a giant basin impact. And then again, it might not. Clementine data will offer intriguing hints, but they can't unwrap the final enigma.

Sampling missions to all the swirl regions would prove once and for all how old the swirls are and whether they match the surrounding terrain, each other, and their associated magnetic fields. But sampling missions like this are expensive. A cheaper, simpler alternative would be a small spacecraft in lunar polar orbit. The only instruments it would need are a magnetometer and an electron reflectance meter, such as the Apollo subsatellites had. The spacecraft's orbit should be low, 30 km to 70 km, and a variable altitude would be even better. Such a polar-orbiting satellite could map the Moon's magnetic fields and finally reveal whether they're linked to the swirls.

Is there any nation planning such a mission?

NASA's Lunar Observer was supposed to be the next mission after Mars Observer, but it has been canceled. Japan may be planning a mission, but the Japanese Space Agency office in Houston confirms only that a small group is discussing it and nothing is planned at present. The European Space Agency has studied the rationale for a lunar base, written a report, and is now defining human exploration options for the Moon — plans that include a remote sensing orbiter by soon after the turn of the century.

Perhaps the only mission that might address the Moon's mysteries soon is Lunar Prospector. Alan Binder is a planetary scientist with Lockheed Engineering & Sciences Co. in Houston who has worked for years to realize Prospector. When contacted this spring, Binder felt Prospector had a strong chance of getting funding. ("But I would not lay my hand in the fire," he cautioned.) If the spacecraft does get funding, Binder says it could be ready for launch in 18 to 20 months. It would fly in lunar polar orbit at 100 km altitude. While Binder acknowledges this is too high to detect magnetic fields, he says the plan is to lower the orbit after initial goals have been met. These include mapping the lunar surface composition, searching for water ice, mapping solar-wind-implanted hydrogen, finding traces of carbon monoxide, carbon dioxide, and/or nitrogen, and determining how the Moon's gravity field varies. Then would come mapping the Moon's magnetic regions.

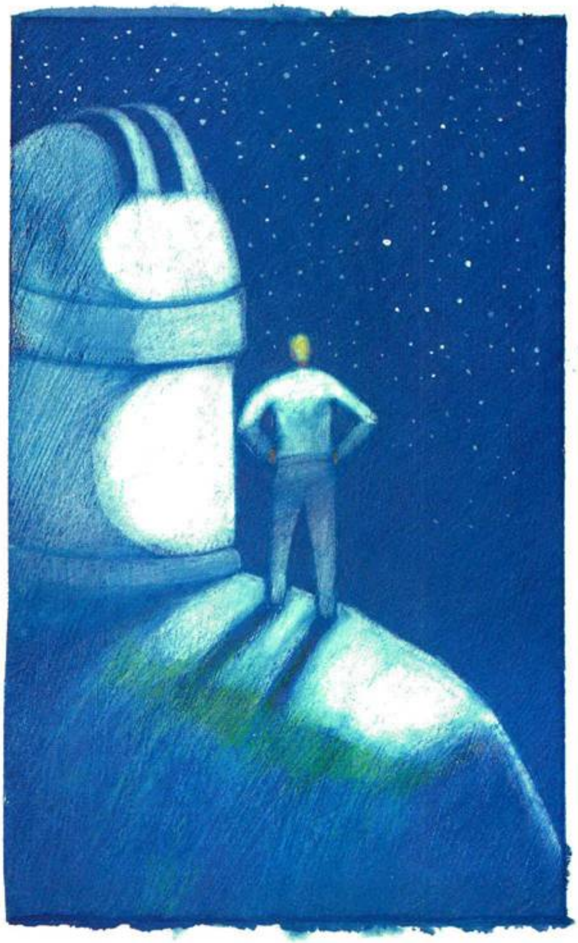
Twenty-five years after Apollo 11, the mystery of the lunar swirls remains as compelling as ever. The Moon is close and mission requirements are relatively light. While Clementine will undoubtedly help clarify the mystery, only a closer survey is likely to solve it. Perhaps the most intriguing mystery of the lunar swirls is why they remain an enigma still. □

Bridget Mintz Testa is a science writer and engineer living in Houston. Her last article for ASTRONOMY *was "The Fate of the Moon Rocks" in December 1985.*

Where Have All the Black Holes Gone?

Twenty years ago, astronomers thought stellar black holes were everywhere. Today they have only three good candidates. What happened?

by Barry Parker



On December 12, 1970, astronomy changed. Scientists launched the first X-ray satellite, Uhuru, from the coast of Kenya, Africa. The satellite detected dozens of X-ray sources soon after its launch and a total of 339 sources within two years. It soon became apparent that the power of many of them varied in time; most pulsed regularly but a few did so randomly.

Astronomers struggled to understand the new sources. What was producing the X rays? They found optical counterparts in the positions of some of the X-ray sources and deduced they were produced in binary star systems, with one of the two stars too faint to see. Theorists joined the quest and soon formulated a model explaining the X rays: Material from the surface of the visible star was being pulled into orbit around the invisible component. It spiraled inward, moving faster and faster, until finally, just above the surface of the dark object, the material reached a speed close to that of light. The material became so hot it emitted X rays.

But what were the invisible objects? Astronomers found the first few were neutron stars, a type that had been identified with pulsars a few years earlier. Neutron stars are small, dense stars only a few miles across composed mostly of neutrons with masses about 1.4 to 3 times that of the Sun. The nature of X-ray binaries seemed resolved, the explanation rather ordinary.

Then everything changed. One of the sources, (which astronomers now call Cygnus X-1), appeared to be different. Astronomers discovered it was associated with a 9th-magnitude blue star called HDE 226868. Paul Murdin and Louise Webster of the Royal Greenwich Observatory in England obtained the star's spectrum and learned the star was a giant, about 23 times as massive as our Sun, lying at a distance of 8,200 light-years, and like the other sources it was part of a binary system. The two objects in the system revolved around one another with a period of 5.6 days.

Because astronomers could estimate the mass of HDE 226868 and knew the period of revolution, they could calculate the mass of the invisible companion. A simple calculation showed it was ten times as massive as our Sun — far too massive to be a neutron star. It had to be a black hole.

Astronomers were excited. Black holes, or at least dense, invisible stars, had been postulated as early as 1784 by the English astronomer John Michell. But it wasn't until 1939 that Robert Oppenheimer and his student Hartland Snyder showed that black holes would be created in the collapse of massive stars. The reaction to Oppenheimer was, to say the least, skeptical.

This skepticism had merit: Black holes have properties that defy common sense and require a fair amount of faith in physical theory. To consider the nature of black holes, remember that late in their lives stars exhaust their fuel, and the nuclear furnace at their center flickers and dies. The cooling core can no longer resist the tremendous inward force of gravity and the star collapses, crushing its atoms to incredibly high densities. If the star is sufficiently massive, everything gets squeezed to an infinitesimal point — a singularity — that is cut off from the outside by a surface called an event horizon. From a distance the event horizon is a black sphere, visible only because it blocks the light from stars behind it.

The event horizon is tiny compared to the star that created it — only a few miles across — but once matter falls inside it, it is isolated from the universe. Escape is impossible.

Astronomers longed to identify a black hole, and with the discovery of Cyg X-1 anticipation ran high. Cyg X-1 was one of the first X-ray sources discovered by Uhuru, and astronomers were almost certain that the X rays were generated by material falling into a black hole. In the early 1970s, with many of the X-ray sources still unidentified, many more candidates were expected. Then, in 1978, NASA launched the Einstein X-ray satellite, enabling astronomers to discover another 1,000 X-ray sources. Some of these would almost certainly be black holes, it seemed. But as astronomers studied each source, they found virtually all of them were neutron stars. The number of neutron stars grew while the number of black hole candidates remained stuck at one: Cyg X-1.

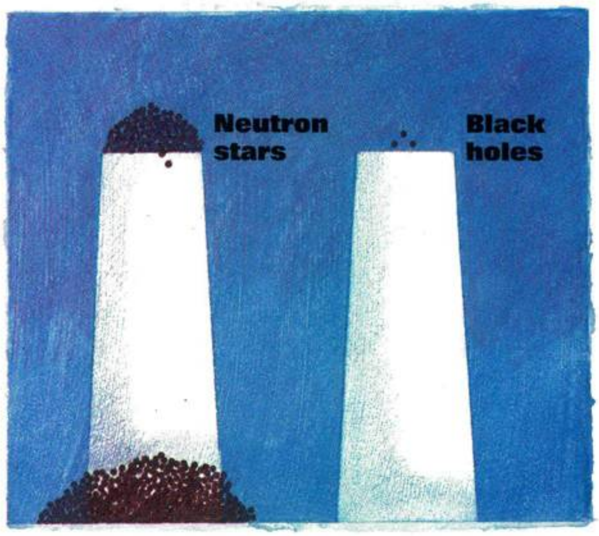
Why so many neutron stars and so few black holes? Black holes should be created in the collapse of stars more massive than those required for neutron stars. The final mass of a black hole has to be greater than three times that of the Sun, but because of mass loss before and during collapse, its original mass has to be considerably greater — at least 10 solar masses, and perhaps much more. Astronomers still don't know. Nevertheless, estimates indicated that astronomers should find one black hole for every three neutron stars. Something was wrong.

Since the identification of Cyg X-1, astronomers have found only two other black hole candidates. During this time they also identified more than 500 neutron stars. Cyg X-1 is still one of the best candidates. But even after 20 years, some astronomers hesitate to accept it as a verified black hole.

The major problem in identifying good candidates is determining their mass accurately. Astronomers know a good candidate has to have a mass at least three times that of the Sun. But to determine the mass of a dark object in a binary system they have to know the mass of the primary, or visible star, and the inclination of the orbital plane of the two objects. In the case of almost all candidates, including Cyg X-1, both of these figures are uncertain. Astronomers know they are not seeing Cyg X-1 edge-on since it is not an eclipsing binary. But what is its inclination? Extensive study over several years has shown that it is probably close to 30°. If so, the dark object's minimum mass is 7 times that of the Sun, and its most probable mass is 16 times that of the Sun.

The uncertainty in the mass of the primary (HDE 226868) is due to the secondary's effect on it. The primary appears to be a large blue star, and we know the mass of stars of this type, but it is possible the secondary has "eaten" away some of its mass. This would make the primary less massive than it should be, and this could complicate determining the mass of the secondary. One study that minimizes the risk of this problem is that by Charles T. Bolton and Douglas R. Gies of the University of Toronto. Their work suggests that HDE 226868 has lost little mass. Furthermore, Bohdan Paczynski and John Bahcall of the Institute for Advanced Study in Princeton have studied the mass of the secondary independent of the primary's mass and find a figure of about 10 solar masses. While the evidence is strong that Cyg X-1 harbors a black hole, astronomers do not yet know conclusively.

They can help their case, however, by comparing Cyg X-1 to the other good candidates. Another called LMC X-3 is associated with an X-ray source in the Large Magellanic Cloud, a nearby galaxy named for the 16th-century explorer Ferdinand Magellan. Anne Cowley of Arizona State University and David Crampton and John Hutchings of the Dominion Astrophysical Observatory in Canada showed that LMC X-3 appears to be a strong black hole candidate.



What astronomers long suspected were hundreds of black holes turned out to be neutron stars, leaving only three stellar black hole candidates.

Cowley and her colleagues began surveying a number of Magellanic Cloud X-ray sources in the mid-1970s. They obtained spectra of a number of black hole candidates, but were unable to prove any of them were black holes. Then the Einstein satellite determined far more accurate positions of the sources. Shortly after the new data became available Cowley noticed that the spectrum of one of the sources was different in two different places.

"I was sure something was wrong," she said. She decided to follow up on the discovery in 1982 when she and Dave Crampton had time at the Cerro Tololo Inter-American Observatory in Chile. After taking several spectra of the object they noticed that the difference was, indeed, real. The spectral lines were shifting. It was a binary system and one of the two objects was invisible. The visible component was a 17th-magnitude main sequence star that had an incredible orbital velocity of 146 miles per second. It orbited the collapsed object in only 1.7 days. The collapsed object had to be very massive. Was it a black hole?

Cowley and Crampton were excited. "Someone asked us what we were working on at supper that night," says Cowley. "It was quite funny. We were really hesitant to say that we had found anything because you go back home and reduce your data and everything goes away." They checked their results when they got back to Victoria, Canada, and were pleased to find that the result didn't go away. Everything checked out. The invisible companion appeared to have a mass of nine suns and therefore had to be a black hole. As in other cases, however, there were uncertainties. Nevertheless, the minimum possible mass was 3 solar masses, which was still large enough to be a black hole. With refinements they now believe that the most probable mass is between 4 and 11 solar masses. It remains an excellent candidate.

A third candidate called A0620-00 was discovered in the mid-1980s by Jeffrey McClintock of Harvard-Smithsonian and Ronald Remillard of the Massachusetts Insitute of Technology. They were interested in finding a binary system where the invisible object had a mass much greater than that of the visible one. "A system like Cyg X-1 is not what you really want," explains McClintock. "The massive star doesn't orbit the black hole. The two objects orbit a point roughly midway between them — their center of mass." McClintock wanted to study a low-mass star that was orbiting a massive invisible object. In this case a more direct measure of the mass of the invisible object would be possible.

A0620-00 was a recurrent nova, an exploding star that had erupted in 1917 and again in 1975. For two months in 1975 it was the brightest X-ray source in the sky, but 15 months later it faded to its original magnitude, and within two years the X-ray emission had stopped. McClintock and Remillard decided to investigate. They found that the visible component was a dim orange star with approximately half the mass of the Sun. Its velocity around its invisible companion was almost half a million miles an hour, its orbital period only 7.8 hours. As in the case of most other X-ray binaries the X-rays were not eclipsed, so we were not seeing it edge-on. After careful study they determined we were seeing its orbit at an angle of about 45°, and the mass of the invisible object was about 9 times that of the Sun.

McClintock was pleased. Others soon verified their estimate and A0620-00 is now considered by most astronomers working in the field to be the best candidate. "I'd like to find another system like A0620-00 that has an even higher velocity secondary, with a short period," McClintock says.

These three best candidates are the only ones astronomers have complete data on. Several others, however, are worth mentioning. One is called CAL 87, an X-ray source in the Large Magellanic Cloud studied extensively by Cowley and her colleagues. The optical counterpart has a magnitude of 19, making it one of the dimmest candidates. It is different from the others in that it is an eclipsing binary with a period of 10.6 hours. Its mass is 4 solar masses, enough to make it a black hole. It's a particularly interesting source in that it is the only eclipsing system, so astronomers are certain of the inclination of its orbit.

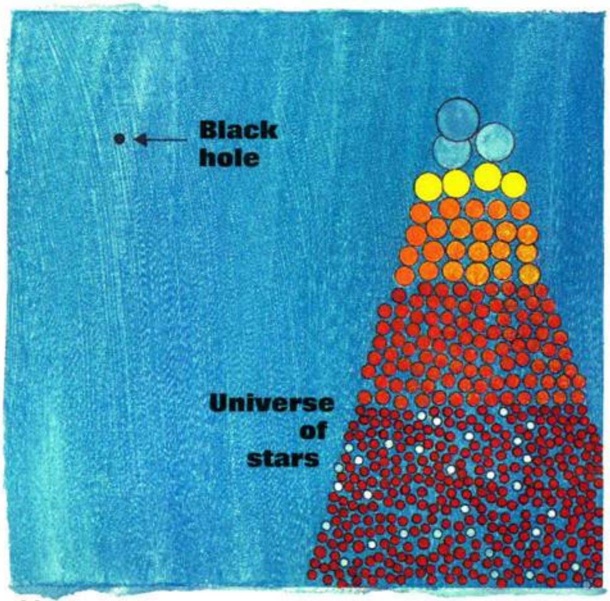
The brightest X-ray source in the Large Magellanic Cloud, called LMC X-1, is also a candidate. The major difficulty with it is the identity of the visible companion. Two stars are nearby, either of which could be the companion star. One glows at magnitude 12 and the other at 14. Preliminary estimates for the mass of the invisible object give 4 to 10 solar masses.

Why are we having so much trouble identifying good candidates? One reason is their size. Black holes are only a few miles across and they give off no light, so astronomers have no way to detect them directly, even with their largest telescopes. Astronomers can detect them only by looking for their effects on neighboring stars, and this, in a nutshell, is the problem. Black holes have only three properties — mass, electrical charge, and angular momentum (spin) — and this limits the ways in which they can affect a neighboring star.

But why are they more difficult to detect than neutron stars, many of which are also in binary systems? Neutron stars have strong magnetic fields. The magnetic field directs the infalling gas toward the star's magnetic poles. This produces two beams of X rays, and as the neutron star rotates, astronomers can detect regular pulses. This does not happen in the case of black holes. Rapid "flickering" of the X-rays occurs in some cases. In Cyg X-1, for example, flickering down to time scales of milliseconds occurs. Furthermore, lone neutron stars, or pulsars, give off a signal. The neutron star in the Crab Nebula, for example, emits both visible and radio pulses. Lone black holes can emit nothing and therefore are not detectable.

The short lifetime of an X-ray source is also a factor. The evolutionary stage of an X-ray binary may last only 10,000 years, which astronomically speaking is very

Massive stars, which produce black holes, are rare, so few black holes exist.



Distant active galaxy

short. And perhaps the most important factor of all is the large mass required for a star to produce a black hole. Only a small fraction of stars have such a large mass.

The black holes we've surveyed so far come from the collapse of massive stars. They're all roughly the same size, namely a few miles across. Much larger black holes may exist in the centers of many galaxies. Serious interest in central black holes in galaxies arose shortly after the discovery of quasars — objects that were found to be giving off hundreds, even thousands of times as much energy as ordinary galaxies. It was soon clear that a new mechanism for producing energy was required, and many astronomers began to wonder if black holes could be responsible.

The British astrophysicist Donald Lynden-Bell put forward a model in 1969 showing how this energy could be generated. He envisioned a giant accretion disk similar to the one around Cyg X-1, but much larger. Stars and gas would be caught up in the gravitational pull of the black hole and pulled into orbit around it. The gravitational sphere of influence of a massive black hole might be a million times greater than the radius of the black hole itself, so any stars in the region would eventually be pulled into it. Surprisingly, this region would still be only a few light-days across. If the black hole had a mass of, say, one billion suns, and was at the center of the solar system, its surface would intersect Uranus' orbit, and its accretion disk would be 100 times farther out than Pluto. Anything caught up in the accretion disk would increase in speed as it spiraled closer to the black hole, and just as in the case of the smaller disk, heating would occur as particles collided until finally its temperature was high enough to produce X rays.

After three decades of study, astronomers are now relatively confident that this model is correct, but problems remain. The difficulties are in the details, not the overall model. A black hole would transform mass into energy at a rate 10 to 50 times more efficiently than a star would, but to do this the quasar, or active galaxy, would need a large supply of matter. How does it continue to pull in matter at such a tremendous rate over such a long period of time? Astronomers are not certain.

Eventually, of course, quasars and active galaxies run out of fuel. When this happens the black hole is still there, but it no longer gives off energy. The quasar or active galaxy then becomes a "docile" galaxy like the ones around us.

In their search for evidence of massive black holes, astronomers look for two things. If a massive black hole is present, it would attract stars and the intensity of light near the center would be high. Astronomers therefore measure the light across the centers of galaxies to detect a sudden increase near the center. Using spectra, they check the velocity of stars in this region. The closer a star is to the black hole, the faster its orbital speed should be. In fact, very close to the black hole velocities would approach that of light.

Active galaxies probably contain central black holes but their great distances make them difficult to study.

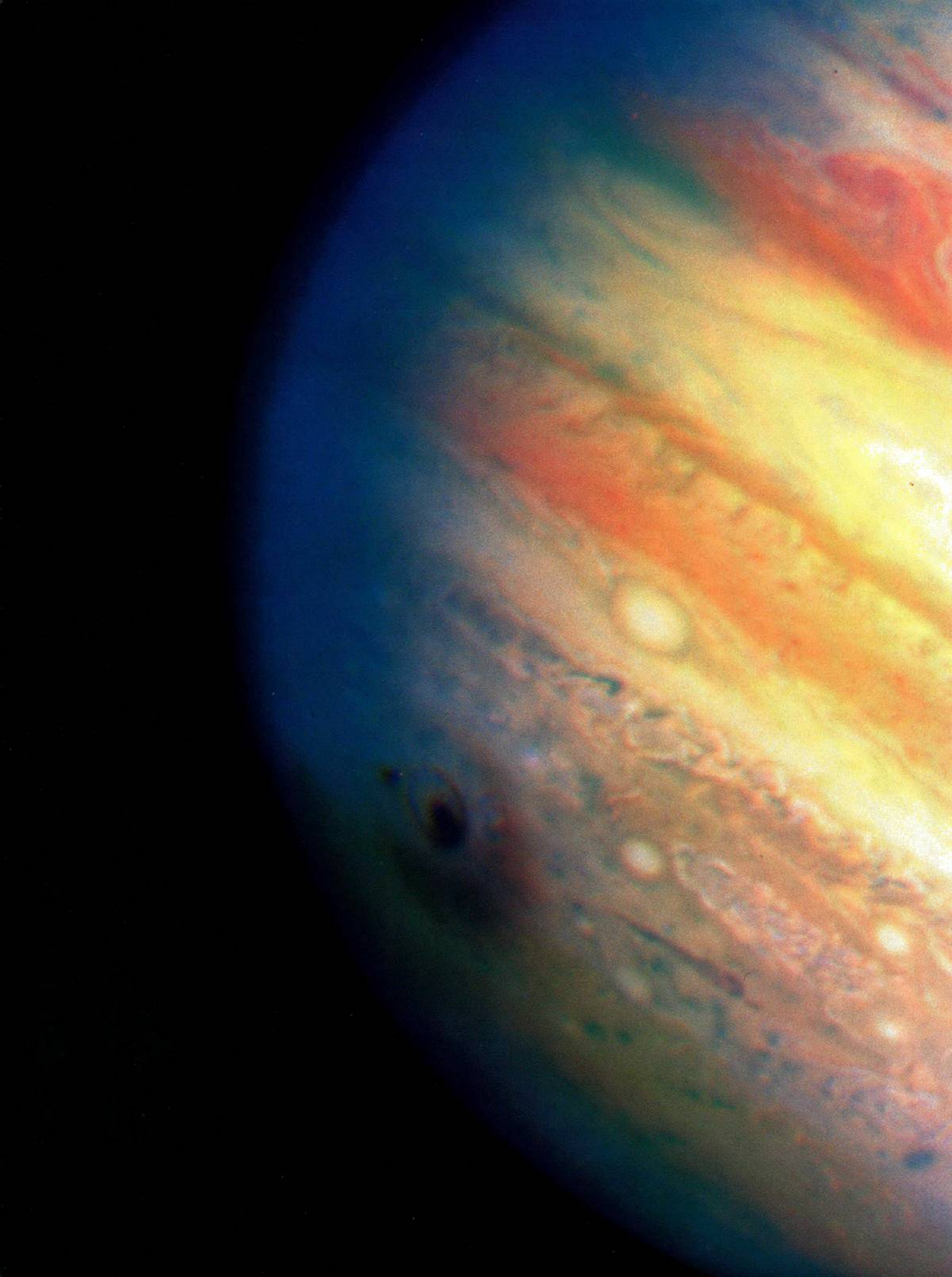
In June, Holland Ford and other astronomers using the Hubble Space Telescope found conclusive evidence for a massive black hole in the center of M87, a giant elliptical galaxy in the Virgo Cluster. The speed at which the galaxy's nuclear disk rotates, 500 km/sec, means the galaxy must have a mass of 3 billion suns in its center. The only suitable explanation for this much mass is a black hole. That brings the number of serious black hole candidates to four, the candidates for extragalactic black holes to one. This conclusive evidence followed years of growing suspicion. In 1979 Peter Young and Wallace Sargent found spectral evidence for a compact and very massive object in the core of the M87, an active galaxy with a jet merging from it. The mass of the object at the center was about 5 billion solar masses, and it was small — about twice the size of the solar system.

The major difficulties with most active galaxies and quasars is that they are too far away for detailed study. So Alan Dressler of the Carnegie Institution and John Kormendy of the Institute for Astronomy in Hawaii independently decided to concentrate on nearby galaxies. Using CCDs they studied the cores of several nearby galaxies.

Kormendy studied the Andromeda Galaxy (M31), the Sombrero Galaxy (M104), M32, M33, NGC 3115, and several others. After measuring their brightness profiles and determining the velocities of the stars near the center, he concluded that the Andromeda Galaxy and NGC 3115 were both excellent candidates. Both are docile galaxies, so their black holes are not being fueled. But there is considerable evidence that they contain black holes. The Andromeda Galaxy has a cluster of rapidly rotating stars near its center. Measurement of their velocities shows that they surround a dark object of mass 10 million to a billion suns. Is it a black hole? Kormendy won't commit himself. "We don't have proof it's a black hole, only proof that there is a central object that is dark and very massive," he says. A number of astronomers have argued that it could be a cluster of small black holes or neutron stars. Kormendy is convinced that this is unlikely.

It is, indeed, strange that we have found so few black hole candidates. Still, Cyg X-1, LMC X-3, and A0620-00 are probably black holes, and it seems likely that some of the nearby galaxies contain black holes at their centers. The case for black holes in quasars and active galaxies seems strong and is definitely bolstered by the existence of a black hole in M87. So the future is bright, and with the Hubble telescope now repaired and several large ground-based telescopes going into operation in the next few years, the elusive answer to the mystery of black holes seems closer than ever. □

Barry Parker is a physicist at Idaho State University in Pocatello and the author of many articles in ASTRONOMY.



Death of a Comet

More than twenty fragments of Comet Shoemaker-Levy 9 rained down on Jupiter's cloudtops last July, creating Earth-sized, dark brown blots.

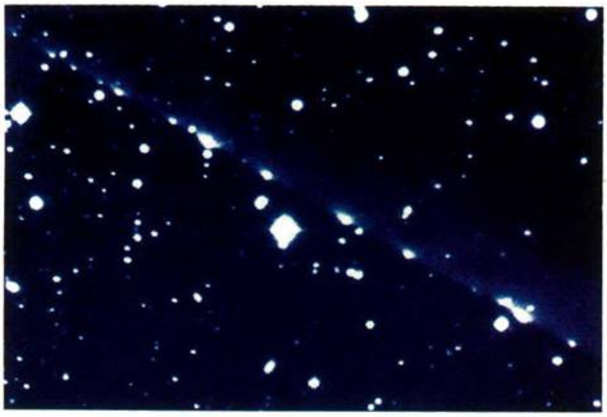
by David J. Eicher

It was a week to remember. Live television coverage from NASA's Goddard Space Flight Center and observatories around the world overlapped with both a tribute to the 25th anniversary of the Apollo 11 Moon landing and a space shuttle flight that became the longest American mission in 20 years. It was the week of July 16-22, 1994, and public attention focused on all things cosmic.

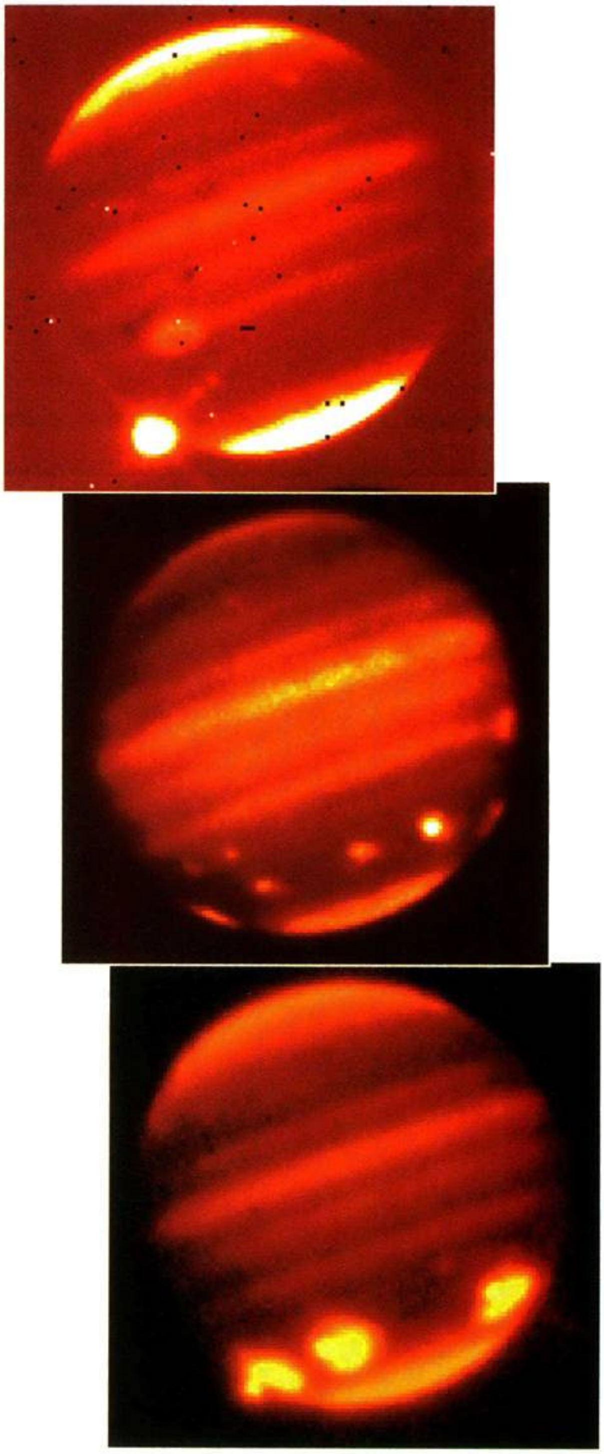
Three events were taking place, but one captured the news like no other in recent memory — the crashes of more than 20 large fragments of Comet Shoemaker-Levy 9 into the clouds of Jupiter. It was an event professional and amateur astronomers had waited more than a year to see, and the comet did not let anyone down. Rather, the impacts exceeded everyone's expectations by producing gigantic disturbances in Jupiter's clouds. These kept the world's observatories frantically busy and backyard astronomers glued to the eyepiece, happily observing the largest spots in telescopes as small as 2 inches in aperture. All that, too, without a direct view: The impacts occurred on Jupiter's night side and thus

A COSMIC BLACK EYE dots the cloudtops of Jupiter after the impact of Shoemaker-Levy's fragment G on July 18, 1994. Remarkable detail exists in this image made with Hubble. The dark, innermost ring surrounding the site spans almost an Earth diameter; the larger ring contains material blown away from the site. The older impact site of fragment D is visible just left of this ring. Two weeks before the impacts began, the comet appeared like an intact string of pearls (below).

Heidi Hammel, MIT/NASA/HST

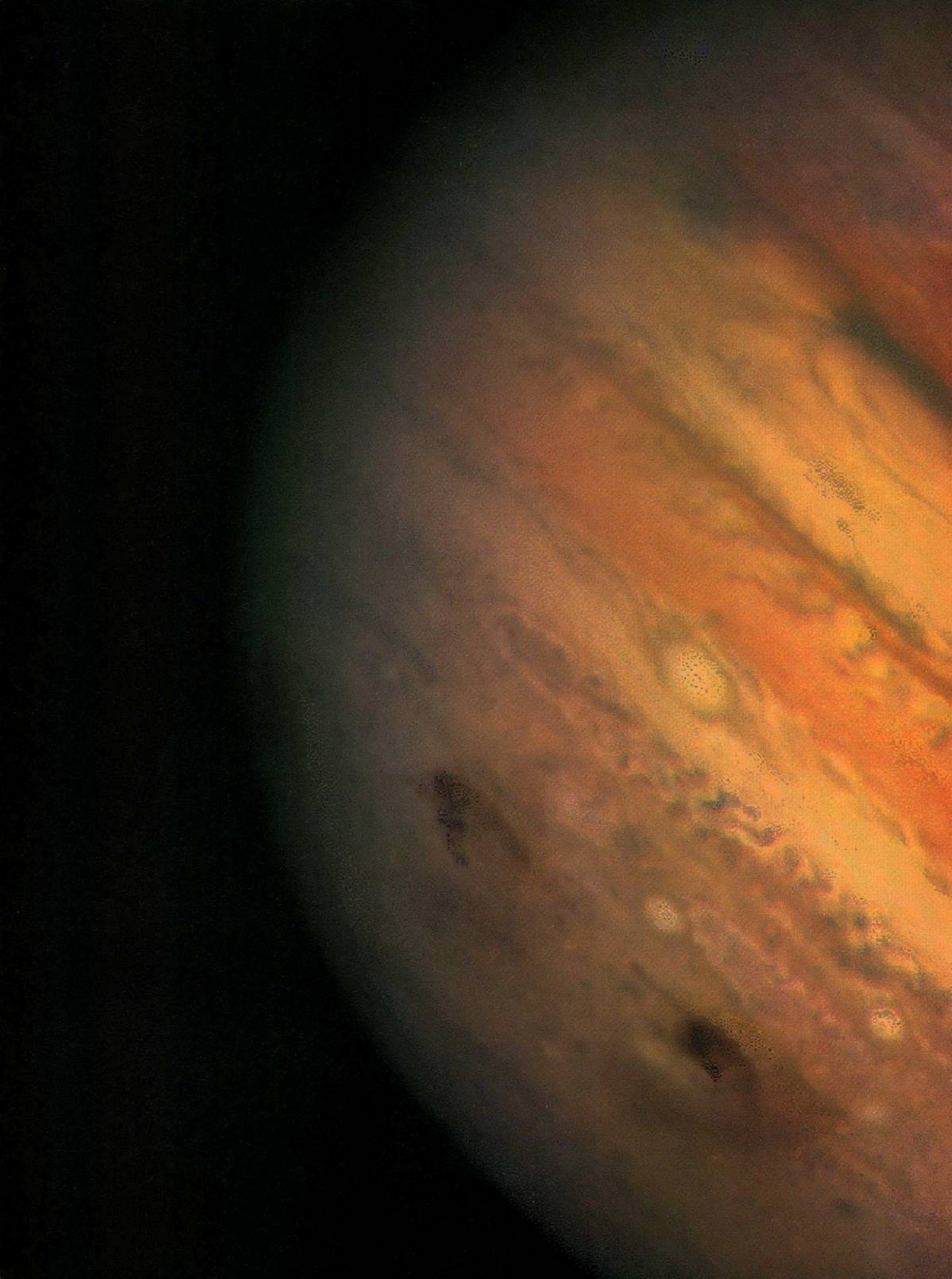


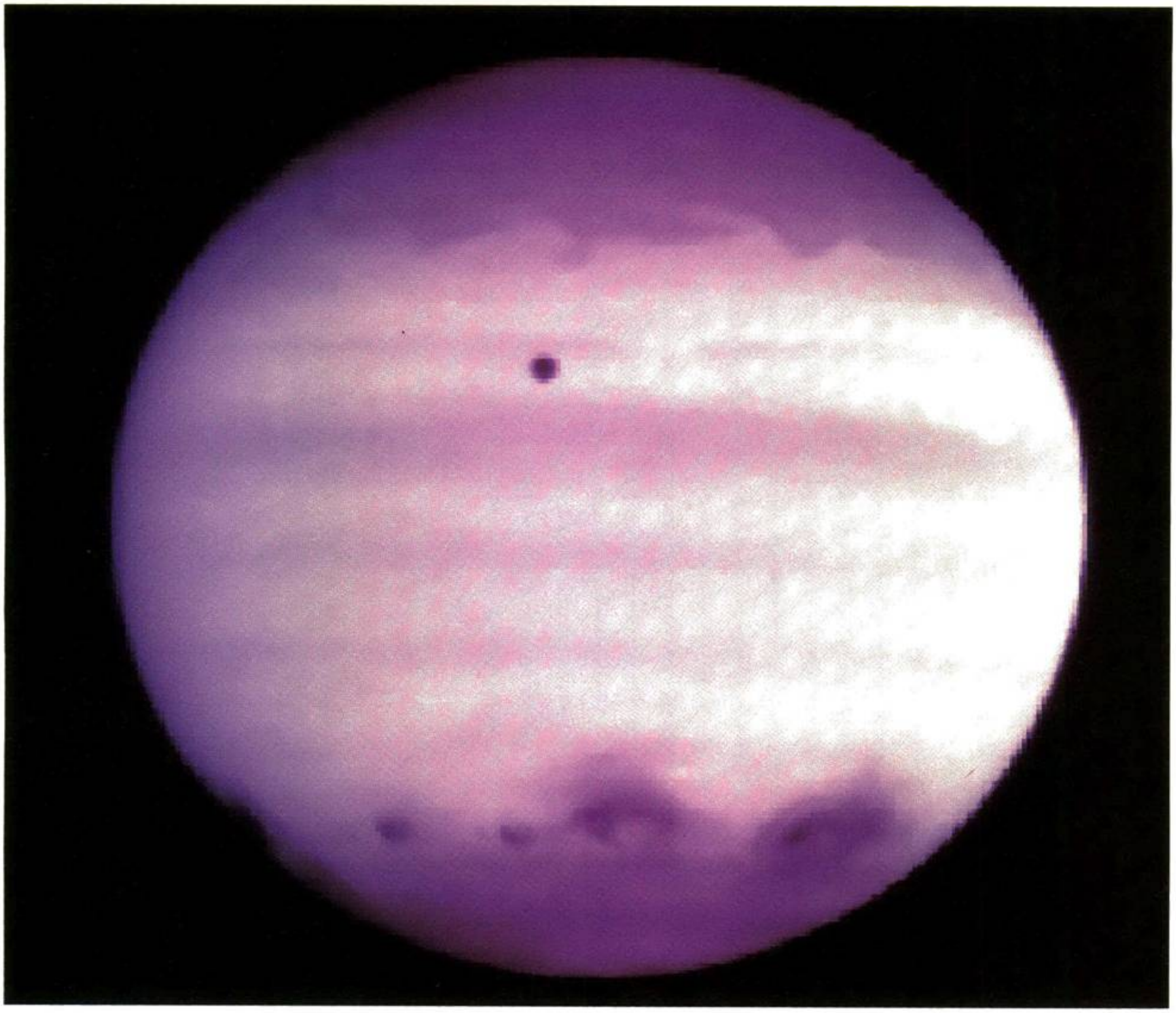
European Southern Observatory



Calar Alto Observatory

GLOWING WARMLY, the comet's impact sites remained visible in the infrared days after each hit occurred. This sequence shows the heat energy from fragment A on July 16 (top), and from multiple impact sites on July 19 (middle) and July 20 (bottom).





NASA/HST

STUNNING DETAILS OF DISASTER showed themselves on many images made with Hubble. On the opposite page, left of center is G and to the lower right L. Hubble's full disk view taken in ultraviolet light (above) shows the impact zones, left to right, of fragments H, N, Q_1, Q_2, R, D/G, and L.

Heidi Hammel, MIT/NASA/HST

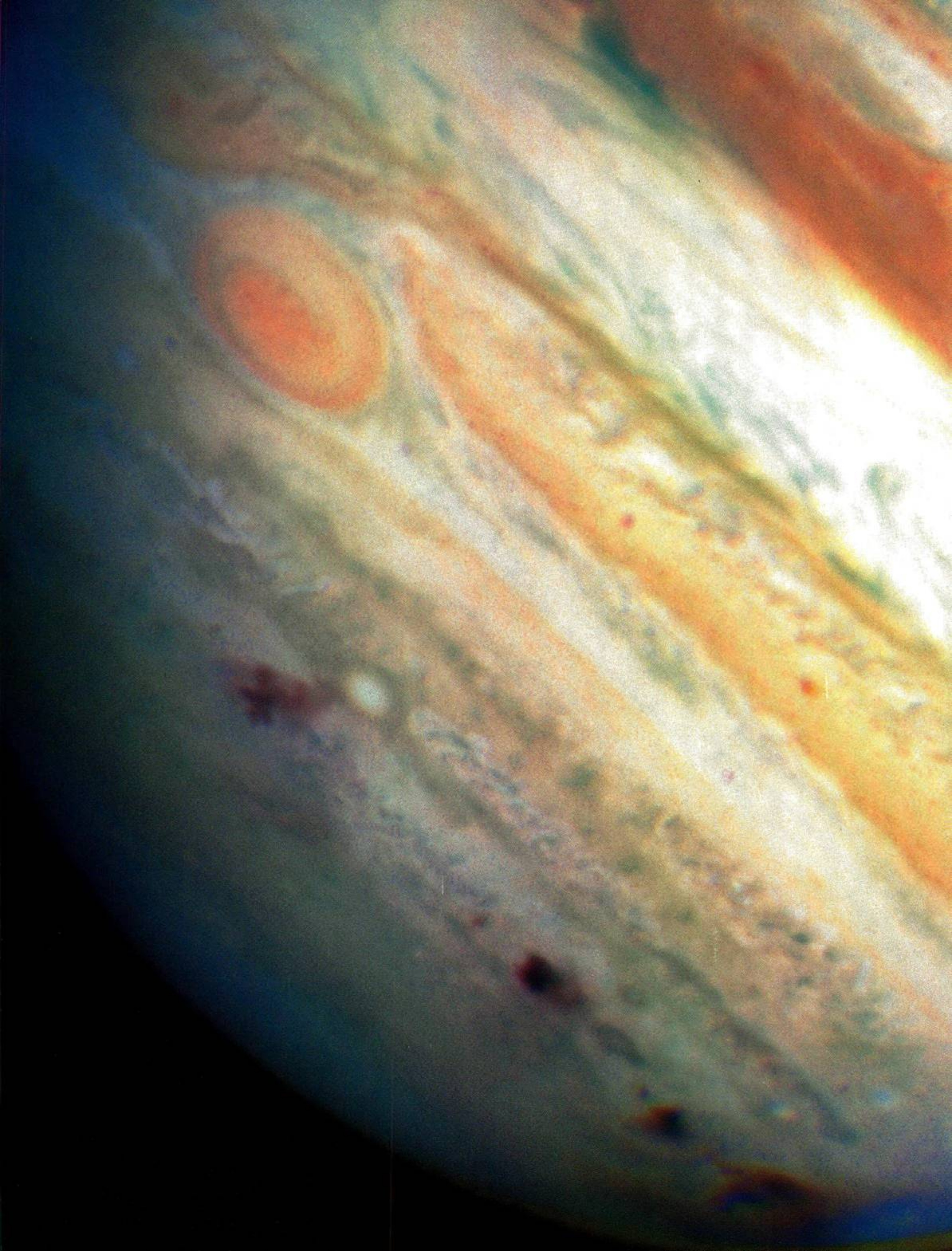
the planet had to rotate several minutes before the sites became visible from Earth. The only direct view of the crashes was that obtained by the Galileo spacecraft, whose data would be sent slowly back to Earth for arrival in August.

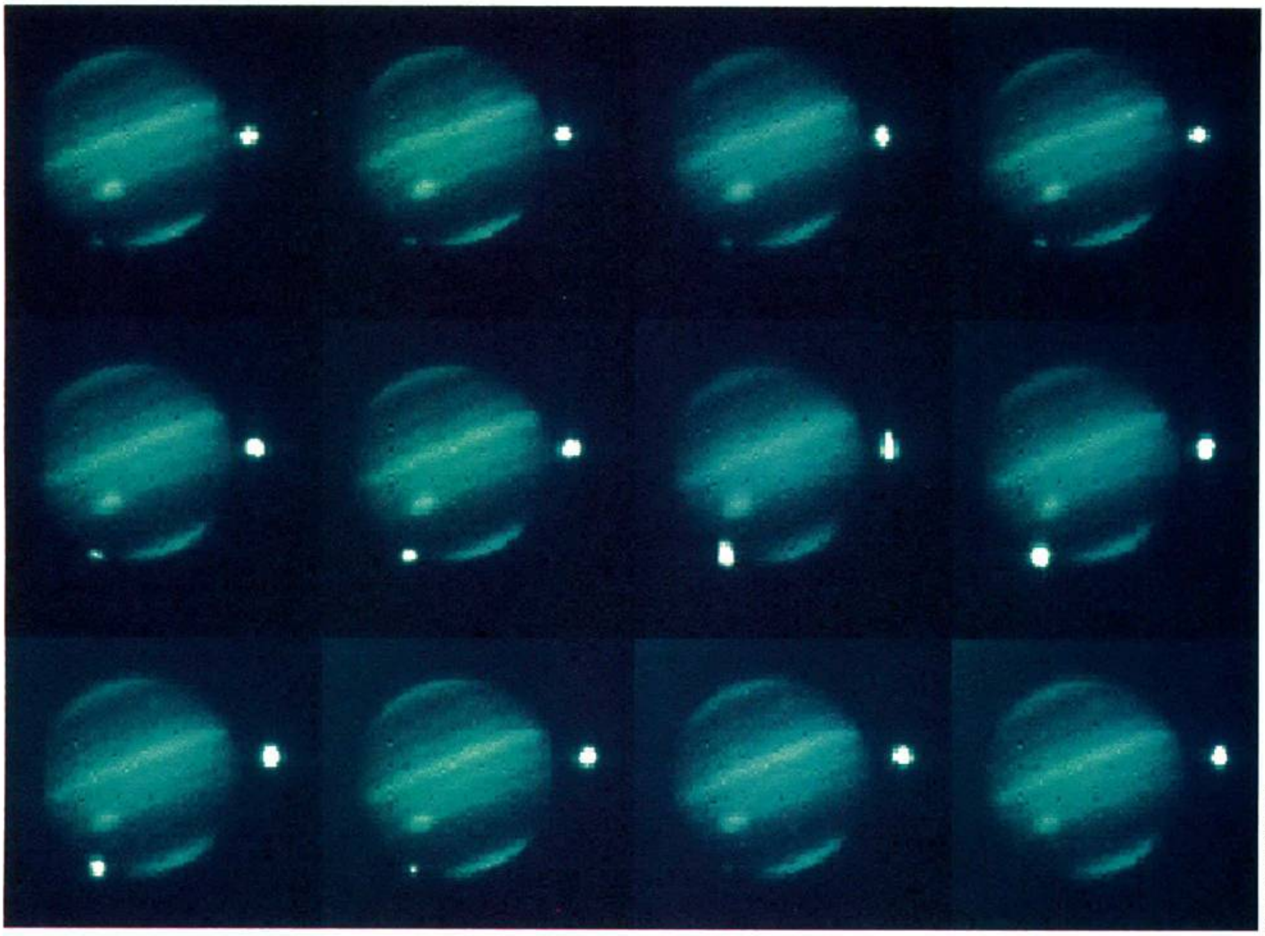
The comet had been discovered at Palomar Observatory by Gene and Carolyn Shoemaker and David H. Levy in March 1993. Captured by Jupiter's gravitational clutch more than a century ago, the comet broke apart under Jupiter's tidal forces two years ago. When Carolyn Shoemaker first saw the comet's image she described it as a "squashed comet." Orbits calculated from the comet's position made clear that the glowing string of pearls was headed into Jupiter, providing scientists with the first look at such a large-scale impact in recorded history. Hopes were running high, but nobody knew the answer to the $64,000 question: How big are the fragments and how much bang will there be?

On Saturday, July 16, the fears quickly dissipated. Astronomer Heidi Hammel and her colleagues gathered at the Space Telescope Science Institute huddled around a computer screen waiting for the first image of impact A, one that might reveal the tenor of the week to come. Screams of delight and the shock of disbelief painted the room: The first images showed a brilliant flash from the "fireball" produced by crash A. Out came the champagne, swigged right out of the bottle.

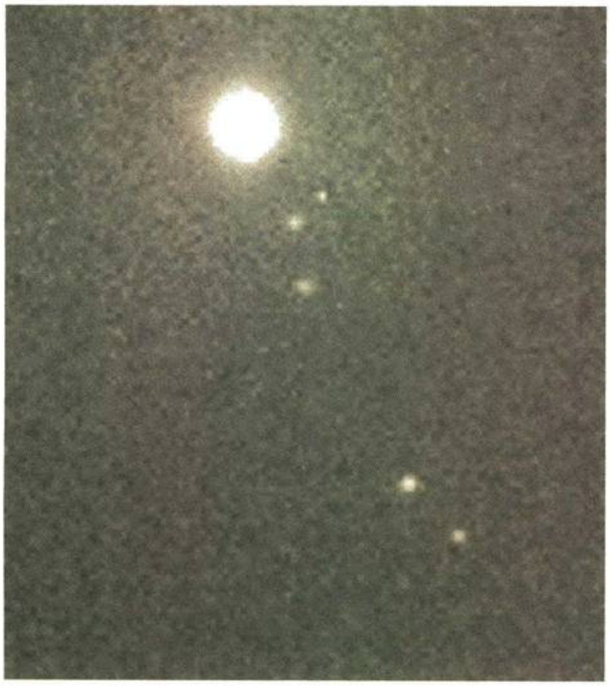
Meanwhile, the world's observatories went into overdrive to collect data on the crash events and produce images for the insatiable media. Influenced by the belief that the crashes would be best visible in the infrared part of the spectrum — perhaps visible *only* in the infrared — most ground-based observatories produced portfolios of infrared data. Keck, Calar Alto, NASA's Infrared Telescope Facility, Lick, Lowell, McDonald, Siding Spring, Mt. Stromlo, Kitt Peak, the South African Astronomical Observatory — all fed images into the electronic bloodstream of the Internet and vied for inclusion as part of the Shoemaker-Levy 9 experience. It was the greatest avalanche of astronomical imagery since, perhaps, the days of the Voyager flybys.

As the week drew to a close, it was clear that the scientific interpretation of the observations would lag behind. "Astronomers will be interpreting the data collected this week for the next 10 years," said Hammel. Clearly the objects were big, the largest between 3 and 5 kilometers across, and produced a significant blast of energy, perhaps as much as 6 million megatons per fragment, according to Gene Shoemaker. The object





Kaz Sekiguchi, SAAO



Univ. of Arizona Obs. at Kitt Peak

A COMET CRASH MOVIE of twelve frames shows an infrared view of the fireball produced by the impact of fragment A on July 16. The bright light on the planet's southeastern limb is the crash; the bright glow to the right of the planet is the moon Io.

EIGHT CRASH SITES speckle the cloudtops of Jupiter in a Hubble image made on July 22 (opposite page). They are, from left to right, the E-F complex (in the planet's limb haze), star-shaped H, the impact sites of N, Q_1, Q_2, and R, and the giant complex created by fragments D and G. At the moment of impact for fragment B on July 16, a telescope at Kitt Peak National Observatory caught four following fragments as they headed toward explosive doom (above).

NASA/HST

was indeed a comet rather than an asteroid, at least based on the observational definition if not its origin.

From spectroscopy and imaging in the methane band, astronomers deduced that the debris fields from the impacts were high in the Jovian atmosphere — much higher than the shearing winds that could have spread the material quickly. Astronomers did not detect water, which they would have expected if the explosions had taken place at deep levels. They suggest, then, that the larger sites could last for some months to come — perhaps a year. Preliminary spectroscopic results suggest that much of the violet-brown gunk spread out of the impact "tunnels," may be material largely from the comet, contradicting the earliest guesses that it was mostly drawn from Jupiter's atmosphere. More detailed chemistry will result from numerous studies carried out during the week. Images and data of several thermal plumes produced by the largest explosions — and seen blossoming as high as 2,000 km above Jupiter's limb —will help astronomers deduce something about the gas dynamics of Jupiter's high level atmosphere. Data from the Galileo spacecraft and from Ulysses, a solar probe, will provide extremely accurate times for the impacts. Many more images from Hubble and ground-based scopes will help astronomers reconstruct exactly what happened during the final hours of this wayward comet, one we will remember for a long time to come. ☐

SKY ALMANAC

October 1994

Mars Cuts Through the Beehive

During the middle of October, Mars passes through the center of the Beehive star cluster in Cancer. The 1st-magnitude planet lies nearest the cluster's center on the mornings of October 17 and 18, though observers with binoculars will get good views for a morning or two before and after that.

Saturn Eclipses One of Its Moons

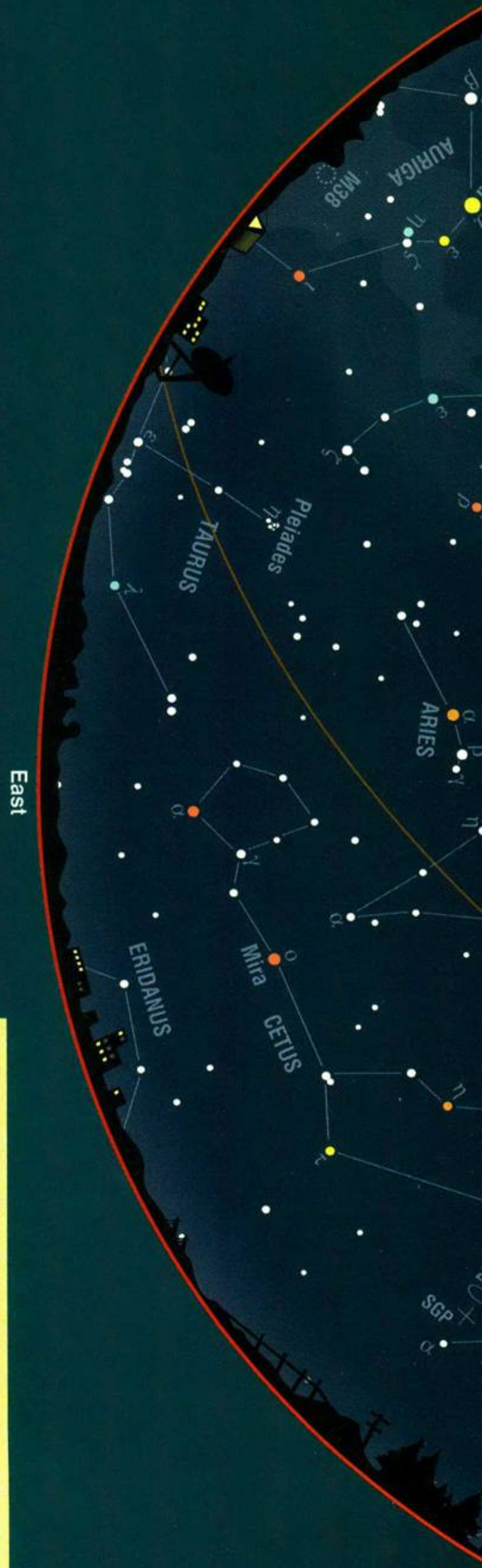
Most of the planetary action is in the early evening sky this month, leaving Saturn the lone bright planet visible after twilight. This offers stunning views to telescope owners and allows observers to devote their undivided attention to the ringed planet, which shines brightly at magnitude 0.7 among the background stars of Aquarius. The most exciting telescopic event for North American observers comes on the night of October 23/24, when the satellite Rhea emerges from Saturn's shadow, the first such eclipse seen in nearly 15 years.

Jupiter Occulted on October 7

As Jupiter sinks into the twilight glare this month, it has close encounters with three other solar system objects. It lies near Venus and Mercury throughout early October, making a pretty grouping for naked-eye observers. Then the waxing crescent Moon occults Jupiter on October 7. Observers in eastern South America will see Jupiter reappear from behind the Moon's bright limb around 7:30 a.m. local time, about half an hour after the Moon rises, while those in the southern Atlantic Ocean and Antarctica will be able to view the event later in the day.

Orionids Peak on October 22

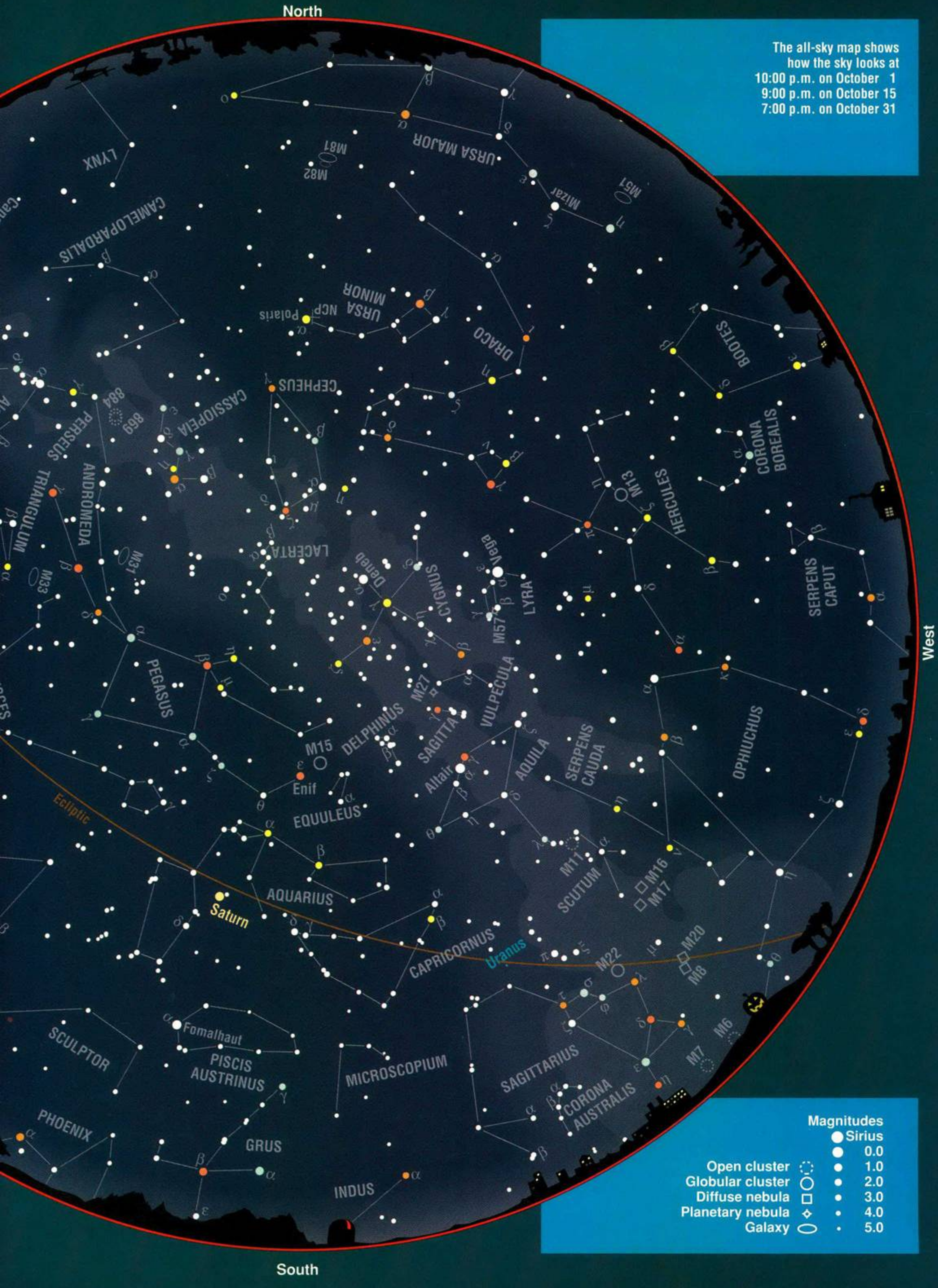
Although the nearly Full Moon hampers viewing of the Orionid meteor shower at its peak on the morning of October 22, you can still catch 10 to 15 of the fast, colorful meteors in the hours before dawn.



CALENDAR OF EVENTS

1	Uranus is stationary, 11 p.m. EDT
2	Neptune is stationary, 10 a.m. EDT
4	New Moon is at 11:55 p.m. EDT
6	The Moon is at perigee (223,845 miles from Earth), 10:07 a.m. EDT The Moon passes 3° north of Mercury, 2 p.m. EDT
7	The Moon passes 7° north of Venus, 6 a.m. EDT The Moon passes 0.7° south of Jupiter, 8 a.m. EDT
8	Draconid meteor shower peaks
11	First Quarter Moon is at 3:17 p.m. EDT The Moon passes 4° north of Neptune, 9 p.m. EDT The Moon passes 5° north of Uranus, midnight EDT
15	The Moon passes 7° north of Saturn, noon EDT
19	Full Moon is at 8:18 a.m. EDT
21	Mercury is in inferior conjunction, 1 a.m. EDT The Moon is at apogee (252,338 miles from Earth), 9:53 p.m. EDT
22	Orionid meteor shower peaks
27	Last Quarter Moon is at 12:44 p.m. EDT
28	The Moon passes 7° south of Mars, 9 a.m. EDT

The all-sky map shows how the sky looks at
10:00 p.m. on October 1
9:00 p.m. on October 15
7:00 p.m. on October 31


North
South
West
LYNX
URSA MAJOR
M81
M82
Mizar
M51
CAMELOPARDALIS
URSA MINOR
NCP
Polaris
DRACO
BOOTES
CEPHEUS
CASSIOPEIA
PERSEUS
884
869
CORONA BOREALIS
HERCULES
M13
TRIANGULUM
ANDROMEDA
LACERTA
M31
M33
Deneb
CYGNUS
Vega
LYRA
M57
SERPENS CAPUT
PEGASUS
VULPECULA
M27
SAGITTA
DELPHINUS
M15
Enif
EQUULEUS
Altair
AQUILA
SERPENS CAUDA
OPHIUCHUS
Ecliptic
AQUARIUS
Saturn
M11
SCUTUM
M16
M17
CAPRICORNUS
Uranus
M22
M20
M8
M6
M7
Fomalhaut
SCULPTOR
PISCIS AUSTRINUS
MICROSCOPIUM
SAGITTARIUS
CORONA AUSTRALIS
PHOENIX
GRUS
INDUS
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
Open cluster
Globular cluster
Diffuse nebula
Planetary nebula
Galaxy

SKY ALMANAC

by Deborah Byrd and Rick Shaffer

Jupiter and Venus closed out September near each other in the west after sunset. This month they are still close and near the waxing crescent Moon on October 7. Because Jupiter is higher in the evening twilight sky, it is the easier of the two planets to see, even though it is much fainter. Venus lies so near the setting Sun that you can see it only because it is so bright. Its brilliance allows Venus to pierce the bright evening twilight near the western horizon in early October.

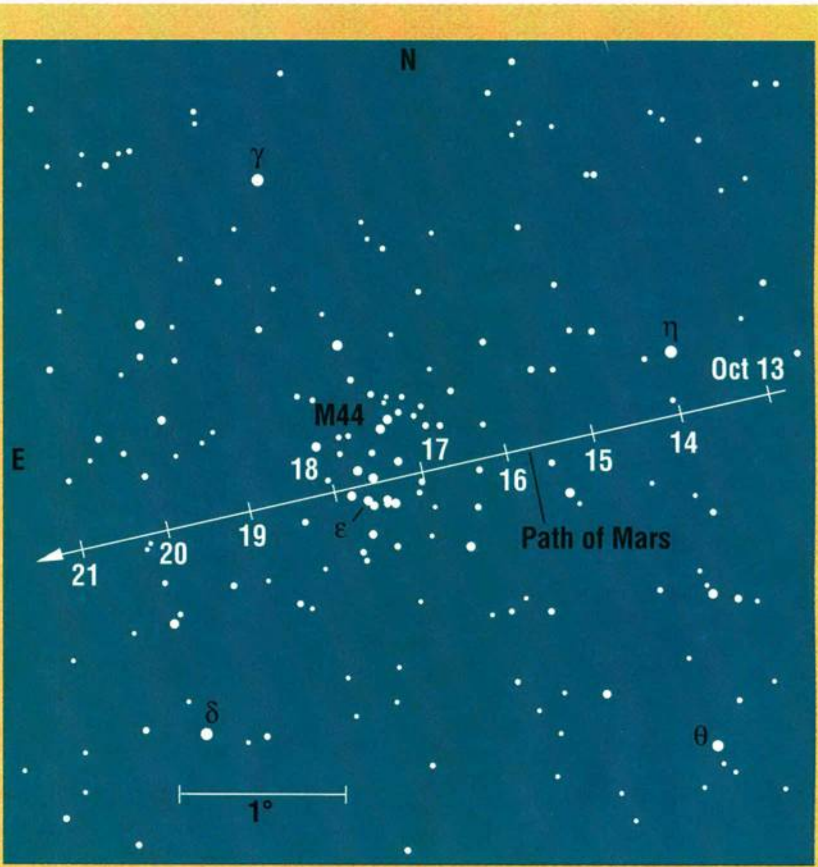
Another planet lurks below Venus, Jupiter, and the Moon on October 7 — Mercury. This evening will be a rare one indeed — with sky conditions so superb they should linger in your memory — if you manage to glimpse elusive Mercury with the naked eye. Autumn is the worst time of year to see Mercury in the evening because the ecliptic — the path of the Sun, Moon, and planets across the sky — makes a very shallow angle with the western horizon.

Binoculars will increase your chances of seeing Mercury. But a slight haze or clouds near the horizon may well blot it from view.

This month be sure to get up early to see Mars. Late last year this planet was in conjunction with the Sun — behind the Sun as seen from Earth. It returned to the predawn sky in February and has since remained low in the east before dawn. For most of the year, it has appeared as a faint, inconspicuous dot of ruddy light.

Now, because Earth's orbit around the Sun is smaller than Mars' and thus our planet is moving faster, Earth is beginning to catch up to the Red Planet. As we do so, Mars' brightness increases.

Mars Meets a Swarm of Bees



The Red Planet is a fairly inconspicuous dot in the morning sky during most of October, shining at magnitude 0.9 and displaying a disk 6" across. But there's one event this month you won't want to miss. Around mid-October, Mars passes through the heart of the Beehive star cluster (M44) in the constellation Cancer.

The planet appears closest to the cluster's center on the mornings of October 17 and 18 (positions in the diagram and table are for 5 a.m. EDT). Even though the stars in the Beehive glow at a combined magnitude of 3.1, the individual members cannot be resolved with the naked eye. Your best view of the 1.5°-diameter cluster, and of Mars moving through it, will come in binoculars or a rich-field telescope.

This event provides a marked contrast between Mars, which is relatively bright at magnitude 0.9, and the cluster stars. The brightest cluster member is 6.3-magnitude Epsilon (ε) Cancri, and 14 other stars shine brighter than magnitude 7.5. Intrinsically, all these stars are quite a bit brighter than the Sun. At the distance of M44 (slightly over 500 light-years), our Sun would appear as an 11th-magnitude star.

Mars' passage through the Beehive also makes for a good photo opportunity. One method is to use an ordinary 35mm SLR camera loaded with high-speed film (ISO 800-3200). Simply set the camera to its widest lens opening, mount it on a tripod, and make a time exposure of 10 to 15 seconds. For a larger image, attach a telephoto lens to your camera and mount it piggyback style on a well-aligned equatorial telescope. If you snap a picture every clear day from about the 13th to the 21st, you'll get a series of photos that nicely captures Mar's motion.

COORDINATES FOR MARS

Date	R.A. (2000)	Dec.
Oct. 14	8h32.5m	20°04'
Oct. 15	8h34.7m	19°57'
Oct. 16	8h36.9m	19°50'
Oct. 17	8h39.1m	19°44'
Oct. 18	8h41.3m	19°37'
Oct. 19	8h43.5m	19°30'
Oct. 20	8h45.7m	19°23'

The planet shines at magnitude 1.0 when October begins and brightens to magnitude 0.7 by the end of the month. By next February, when Earth passes between Mars and the Sun, the Red Planet will shine brilliantly at magnitude –1.2.

On October 17 and 18, Mars drifts in front of the famous Beehive star cluster (M44). This cluster of a few hundred stars can be seen as a nebulous glow with the naked eye, but binoculars or a rich-field telescope will reveal the individual cluster members.

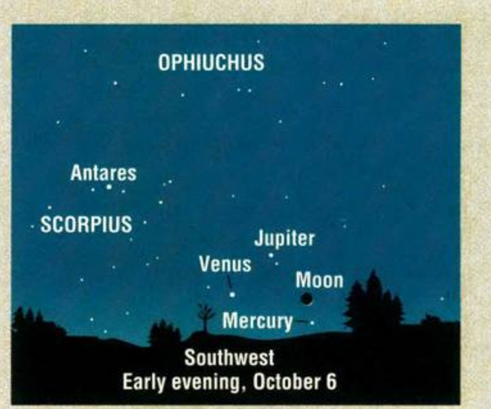
This month's Full Moon, also known as the Hunter's Moon, comes on October 19, just in time to hamper viewing the Orionid meteor shower. Normally you could expect to see 30 meteors per hour around the shower's peak on October 22. This year bright moonlight drenches the sky, however, and many of the meteors will rain down invisibly in the Moon's glare. Still, you should be able to spot roughly 15 meteors per hour at the shower's peak.

The Moon will not interfere with another sort of observation, though — one that would have boggled the minds of early theologians, whose cosmology did not allow for the idea of change in the heavens. The brightness of Delta Cephei ranges between magnitude 3.5 and 4.4 over a period of 5 days, 8 hours, and 48 minutes. You can track the brightness variations of this pulsating star using the chart on page 52.

You will need binoculars or a telescope to follow Comet Borrelly this month, as it brightens to around 8th magnitude. And while you're at it, track the motion of Pallas, one of the so-called Big Four asteroids. It reaches opposition on November 8.

Finally, turn your telescope on Saturn. The planet is fairly easy to pick out for most of the night against the background stars of Aquarius. The planet's famous rings are more open now than they were earlier this year. But the rings still appear more edgewise than

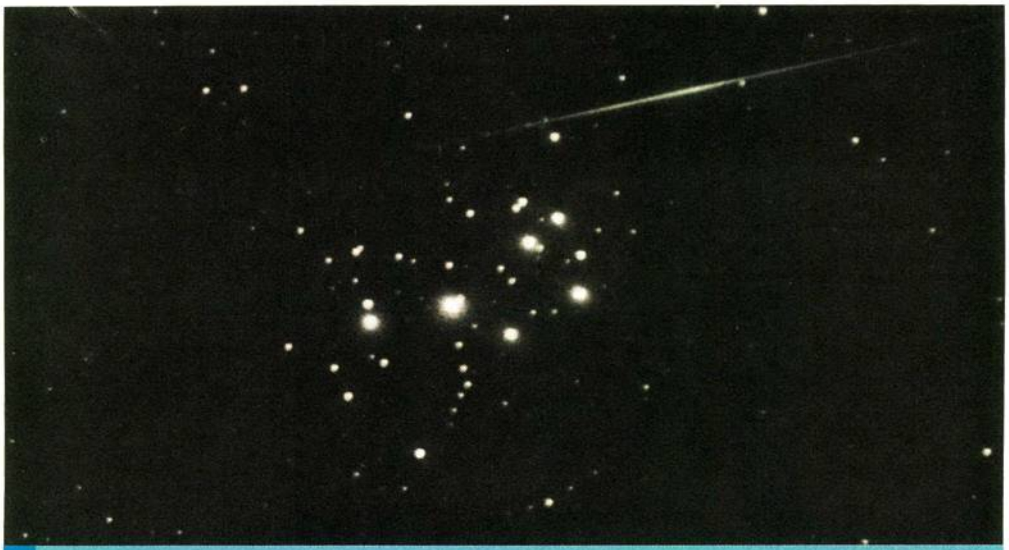
A Gathering of Bright Planets



Be sure to check out the evening sky during early October, particularly on the 6th and 7th, when a slender crescent Moon passes through an area already populated by three bright planets. On successive evenings, you can watch the Moon pass Mercury, Venus, and Jupiter. All three planets, as well as the Moon, lie low in the twilight sky, so find an observing location that offers an unobstructed view toward the southwestern horizon.

Your best overall view of the scene will come with the naked eye or binoculars, though you'll need a telescope to see any details on the planets. On those evenings, Mercury presents a disk 8" in diameter that is about one-third lit. It is by far the most difficult of the objects to see because it is lowest in the sky and shines most dimly, at magnitude 0.6. Venus is much easier to spot, shining brilliantly at magnitude –4.6. Because Venus passes between the Sun and Earth in early November, it now appears as a large, thin crescent. The 45"-diameter planet is just under 20 percent lit on these evenings.

Finally, standing highest in the sky is Jupiter. If you expect the giant planet to appear bigger than Venus, you'll be disappointed. For a few months every couple of years, Venus appears larger than Jupiter, and that's the case now. Through a telescope, the –1.7-magnitude Jupiter displays a disk 32" in diameter.



Seth Horowitz

Meteors from Orion

Bits of dust from that famous celestial visitor, Comet Halley, will be burning up in Earth's atmosphere this month. The shower of meteors that results, known as the Orionid meteor shower, is normally the third best shower of the year. It typically produces about 30 meteors per hour, and the meteors often show color and are fast — smashing into Earth's atmosphere at 42 miles per second.

But to get a decent view this year, you'll have to pick your observing time carefully. The shower peaks on the morning of October 22, just three days after the Full Moon. With bright moonlight washing the sky that morning, you may spot only 10 to 15 meteors per hour. So try viewing the Orionids on the evening of the 22nd. The Moon rises around 8 p.m. local daylight time, so there will be about half an hour of darkness after the end of twilight. Although meteor showers generally put on better displays after midnight, the advantage of a dark evening sky may allow you to spot more meteors.

we've seen in recent years and they will get more so in the coming months. Saturn's rings appear edge-on twice in every 30-year orbit of the planet. The next occurrence is in 1995, when the rings will seem to disappear from our Earthly vantage point.

The edge-on rings present more of an intellectual interest than an observational treat. Instead of being thrilled by the sight of the rings, observers can think about the planet's motion in its orbit, which has caused the rings to appear edge-on. But even without its rings remains of interest to advanced observers, who use the opportunity to view the planet's faint inner satellites, which are usually lost in the glare of the rings. This month some will start watching eclipses of Saturn's moons by the planet itself. Still, Saturn without rings is like a sunbeam with no warmth. Many of you will likely be impatient for the return of Saturn's rings in their broad, golden, and shining form.

October's Planets

In late September, **Mercury** reached greatest elongation, its greatest apparent distance from the Sun. This most elusive of the bright planets lies in the evening sky when October begins, but the shallow angle of the ecliptic to the horizon makes it difficult to see. In fact this is the worst time of year to see Mercury in the evening. Don't count on spotting the planet with your naked eye unless you first find it in binoculars.

October's two brightest planets lie above Mercury in the western twilight sky. At magnitude –1.7, **Jupiter** outshines all the stars. **Venus** is even brighter — now just past its greatest brilliancy of September 28 — shining at a dazzling –4.6. But Venus disappears from view around the middle of the month, as it prepares to pass between the Sun and Earth on November 2.

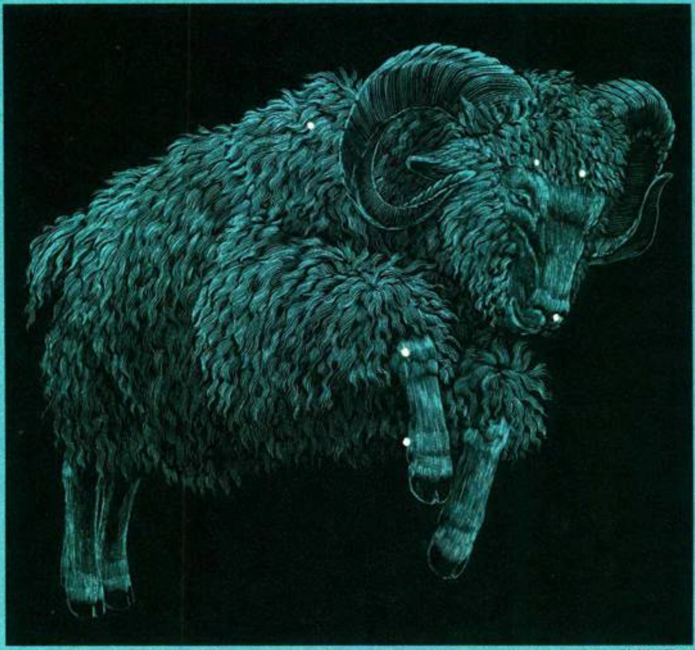
Jupiter too will pass behind the Sun — but on November 17. Jupiter is so low in the sky this month that it swims behind a great thickness of Earth's atmosphere. If you can't resist peeking at Jupiter through a telescope, you'll find a disk that has shrunk to less than 32" in apparent diameter. The planet remains visible until late October, when it too is swallowed up in the bright twilight.

Pluto, which lies in Libra, appears in the west after

THE STARRY SKY

by Deborah Byrd

On October evenings, you can look high in the east to see the zodiacal constellation Aries, the Ram. Alpha, Beta, and Gamma Arietis form a bent line that represents the Ram's horns. These stars are not conspicuous for their brightness, but their pattern is noticeable. Look for them any clear evening to the east of the Great Square asterism in the constellation Pegasus or near this month's Full Moon on October 19.


Keith Ward

Alpha and Beta are much easier to spot than Gamma, partly because they are brighter and partly because they lie only 4° apart. Alpha Arietis is also called *Hamal*, or the "head of the sheep." Some sources say that Hamal was known in ancient Babylon as the Messenger of Light. This star has a magnitude of 2.0 and a distance of 63 light-years.

Beta Arietis is also called *Sheratan*. It shines at magnitude 2.6 from a distance of 50 light-years. Gamma Arietis, whose common name is *Mesarthim*, shines at 5th magnitude from 270 light-years. It is a double star whose two almost equally bright components are seen easily in a small telescope.

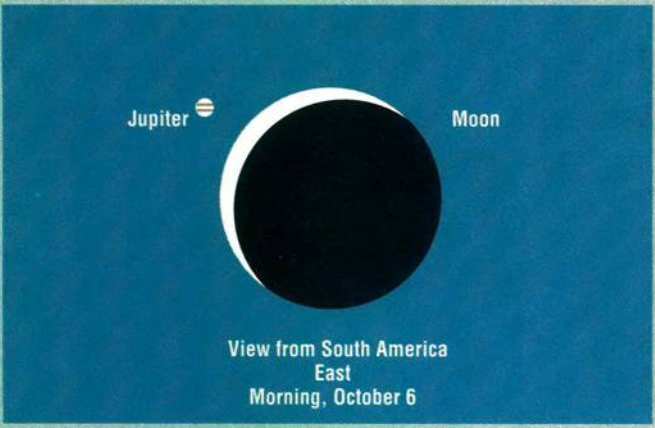
Between approximately 1800 B.C. and A.D. 1, Sheratan and Mesarthim marked the location of the Sun at the March equinox, the first day of spring in the Northern Hemisphere. They were known then, in early Arabia, as the Two Signs. Today, although the Sun's location at the March equinox has moved into the constellation Pisces, the equinox point on the sky's dome is still called the First Point of Aries.

Although Aries is small and inconspicuous, its important location in the sky has spawned a wealth of legends. The primary legend about Aries stems from Greek mythology. In this mythology Aries represented the ram of the Golden Fleece. Some say this ram was the king of the gods himself: Zeus supposedly took a ram's form to escape the pursuit of giants.

In another legend, the ram was sent by Hermes — the messenger god and a god of sleep and dreams — to rescue Prince Phrixus and his sister Helle from a palace plot. The ram tried to carry the prince and princess on his back. Helle fell to her death, while Phrixus clung to the precious fleece as the ram soared over land and sea. The ram carried the prince to a land near the Black Sea, whose king Aeetes welcomed him.

The ram then told Phrixus to sacrifice him to the gods and remove his fleece of gold. Phrixus presented the fleece to King Aeetes, who hung it in a sacred grove, where it was guarded by a sleepless dragon. The golden fleece was so luminous that at night it bathed the land in a golden light.

Later, the golden fleece came to be associated with the voyage of the ship Argo, manned by Jason and his celebrated Argonauts. Meanwhile, for his kindness and generosity, the ram was given a place in the heavens as the constellation Aries. Perhaps the constellation is so dim because Aries had lost his brightly shining fleece by the time he was placed among the stars.



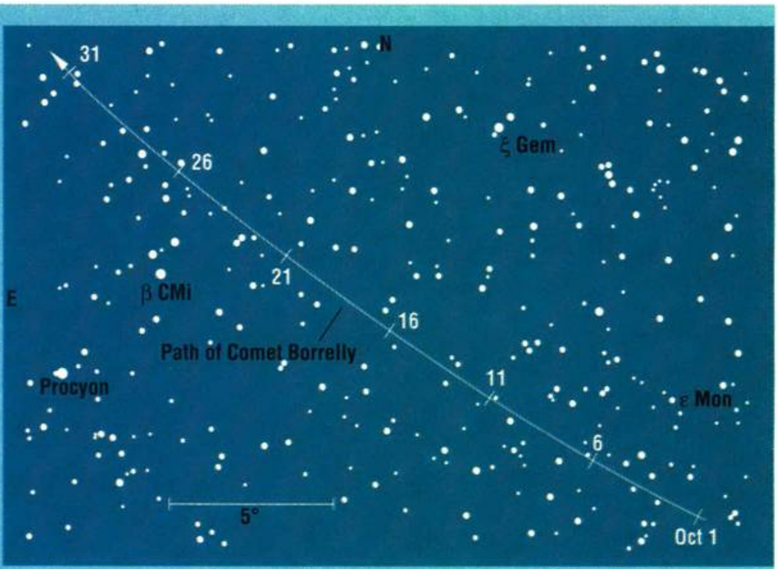
Jupiter Occulted by the Moon

On October 7, the Moon occults Jupiter for observers in eastern South America, the southern Atlantic Ocean, and most of Antarctica. However, the event will be difficult to observe in South America, the most populous part of the occultation's path, because only the reappearance is visible and it occurs low in the eastern sky after sunrise. Complicating things further is that the occulting body is a very young Moon. You must have several conditions in your favor to see the occultation.

First, the optics of your telescope must be scrupulously clean to minimize any stray light from the bright surroundings. Second, it helps to have an accurately aligned equatorial mount with setting circles so that you can "dial-in" the positions of the Moon and planet. Third, you must have a transparent sky to get a good view toward the horizon. A hazy day will have you contemplating what might have been.

You may want to locate the Moon first with binoculars, because the crescent will be lit only eight percent and won't be conspicuous in the daylight sky. On the 7th, the Moon rises around 7:00 a.m. local time and Jupiter reappears shortly after 7:30 a.m. Once you've captured the Moon in your telescope, resist the urge to use an extremely low power. Rather, use a power that just begins to darken the sky. Then center the bright limb of the Moon and keep your eye glued to the eyepiece well before you expect Jupiter to reappear.

Borrelly Brightens in the Morning Sky



This year has provided three reasonably bright comets: Encke, Tempel 1, and Borrelly. Although Encke was the brightest of the three, glowing at 7th magnitude back in January and February, it was low in the twilight sky and not particularly well placed for observing.

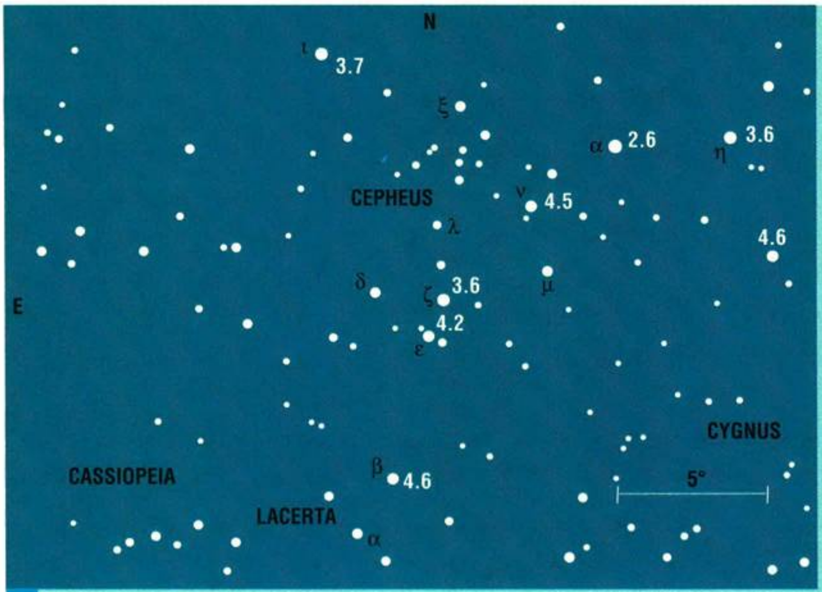
Conditions are much better for 1994's second-brightest periodic comet, Comet Borrelly. It brightens from 9th to 8th magnitude in October, putting on a nice display in binoculars or a telescope in the early morning hours. Borrelly begins the month in the constellation Monoceros, but moves rapidly north and east into Canis Minor. It passes just 3° from the 3rd-magnitude star Beta (β) Canis Minoris on the 25th, which itself is just 4° northwest of 0.4-magnitude Procyon, Canis Minor's brightest star. Positions in the map and table are for 5 a.m. EDT (4 a.m. CDT, 3 a.m. MDT, and 2 a.m. PDT.)

Under a dark sky, Borrelly is easy to find in 7x50 binoculars. But you'll need a large telescope and good observing conditions to see any features in the ball of fuzz. And unfortunately, with Borrelly lying a hefty 1.4 astronomical units from the Sun, it is unlikely that the comet will develop much of a tail.

Martin Hale

COORDINATES FOR COMET BORRELLY

Date	R.A. (2000)	Dec.
Oct. 1	6h20.4m	1°04'
Oct. 6	6h33.3m	2°46'
Oct. 11	6h46.2m	4°38'
Oct. 16	6h59.2m	6°43'
Oct. 21	7h12.2m	9°00'
Oct. 26	7h25.3m	11°33'
Oct. 31	7h38.3m	14°20'



Tracking Delta Cephei

Delta Cephei, one of the most famous of all variable stars, appears high in the north on October evenings and remains well-placed for observing into the wee hours of the morning. Delta (δ) lies in the southeastern corner of the constellation Cepheus, about halfway between 1st-magnitude Deneb, the brightest star in Cygnus, and Gamma (γ) Cassiopeiae, the middle star in the W-shaped pattern of Cassiopeia.

Delta Cephei is the prototype of the Cepheid variable stars, a class of supergiant stars that pulsate and change brightness with regular periods. Earlier this century, astronomers discovered that the period of a Cepheid is related directly to the star's luminosity. So researchers can calculate the distance to a Cepheid by noting its apparent brightness and comparing that with its intrinsic brightness deduced from the period of variability. This property makes Cepheids invaluable in establishing distances both in our Galaxy and the universe (see "Candles to Light the Night," September 1994).

In Delta's case, the star varies between magnitude 3.5 and 4.4 with a precise period of 5 days, 8 hours, and 48 minutes. Observers can easily follow this regular brightening and dimming in binoculars or a small telescope.

First, use the map to locate Delta and some of its neighboring stars that don't vary in brightness. Then choose two of those comparison stars whose magnitudes bracket that of Delta. For example, suppose Delta appears exactly halfway in brightness between Zeta (ζ) Cephei, at magnitude 3.6, and Epsilon (ε) Cephei, at magnitude 4.2. You would then estimate Delta's brightness as 3.9. If you measure Delta's brightness for a couple of weeks, you can build up an accurate light curve showing how its brightness varies over time.

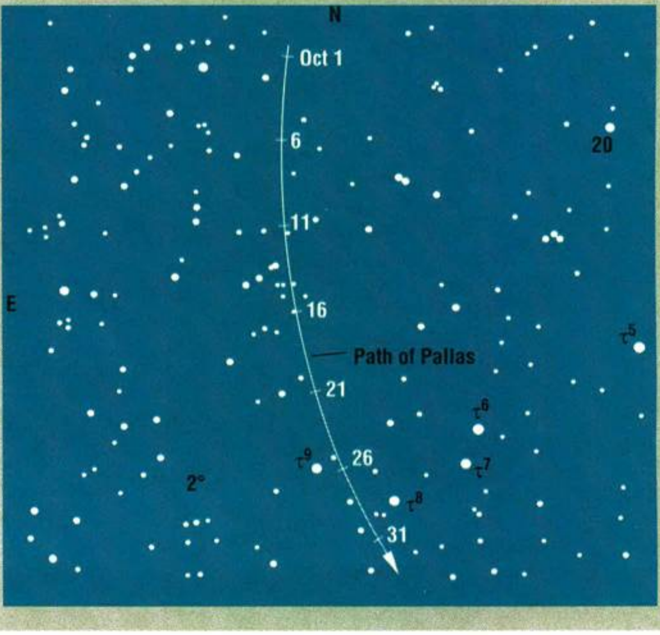
Pallas Heads South

The last few months of 1994 provide several reasonably bright asteroids for you to zero in on. Three of the big four asteroids — 1 Ceres, 2 Pallas, and 4 Vesta — shine at 8th magnitude or brighter this autumn. This month we concentrate on 8th-magnitude Pallas, a 375-mile-wide object that reaches opposition on November 8.

Pallas now is heading south through central Eridanus. This is a relatively star-poor region of sky, so you should have little trouble picking it out from the stellar background. The most interesting conjunction Pallas has this month comes on the mornings of October 26 and 27. That's when it passes between the stars Tau^8 (τ^8) and Tau^9 (τ^9) Eridani, which themselves are separated by less than 2°. Use the finder chart or table of coordinates, which show the asteroid's positions at 5 a.m. EDT, to locate Pallas throughout October.

COORDINATES FOR PALLAS

Date	R.A. (2000)	Dec.
Oct. 1	4h02.5m	–16°10'
Oct. 6	4h02.9m	–17°47'
Oct. 11	4h02.7m	–19°24'
Oct. 16	4h01.8m	–20°59'
Oct. 21	4h00.2m	–22°33'
Oct. 26	3h57.9m	–24°01'
Oct. 31	3h55.0m	–25°24'



sunset. At magnitude 13.8, however, it is a thousand times too faint to see with the naked eye. This planet will also be in conjunction with the Sun in November.

Uranus and **Neptune**, both in the constellation Sagittarius, are still in the south after sunset. Uranus shines this month at magnitude 5.8, while Neptune glows more dimly at magnitude 7.9. Both appear stationary relative to the background stars on October 2, and afterward they resume normal (eastward) motion.

The only planet that's easy to see in the evening this autumn is **Saturn**. You can find the 0.6-magnitude planet among the relatively faint stars of Aquarius. Look for Saturn near the waxing gibbous Moon on October 15.

When the month begins, **Mars** lies high in the southeast an hour before dawn, near the border between Gemini and Cancer. As the month progresses, it cuts eastward across Cancer. Look for it on the mornings of October 17 and 18, when it passes through the beautiful Beehive star cluster (M44).

Mars' angular size increases noticeably this month. In early October, the planet's ocher disk measures 6" across, and it grows to 7" across by month's end. It will swell to nearly 11" by the end of the year. The spring equinox for the northern hemisphere of Mars takes place on October 9. Because we are now looking down on the planet's northern hemisphere, you should be able to see the Martian north polar ice cap in a small telescope. The cap will shrink in the coming months as the weather warms up on the northern half of Mars' globe. □

Deborah Byrd writes and produces the daily "Earth and Sky" radio series. Rick Shaffer is an engineer and writer living in Southern California.

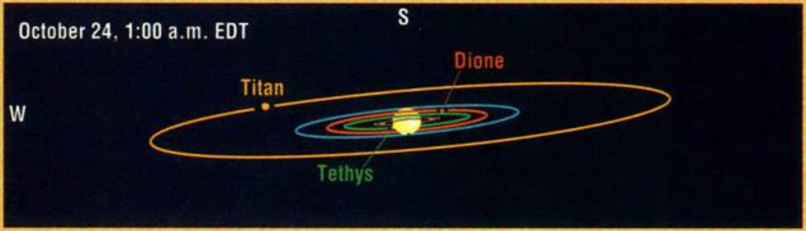
Watching Saturn Eclipse Its Satellites

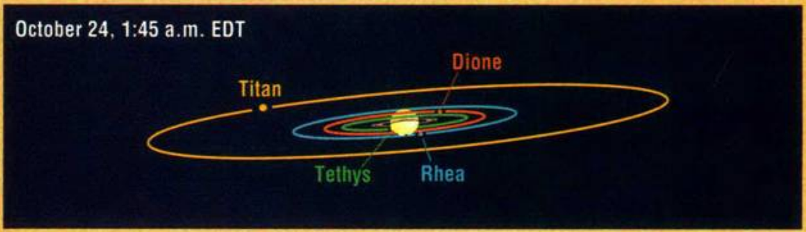
Now just one month past its opposition, Saturn is easy to see in the southeast during evening twilight and remains visible until well after midnight. The ringed planet, whose disk measures 18" across and has rings that span 42", is always a sight to behold. But October brings with it the start of a rare series of events you certainly won't want to miss.

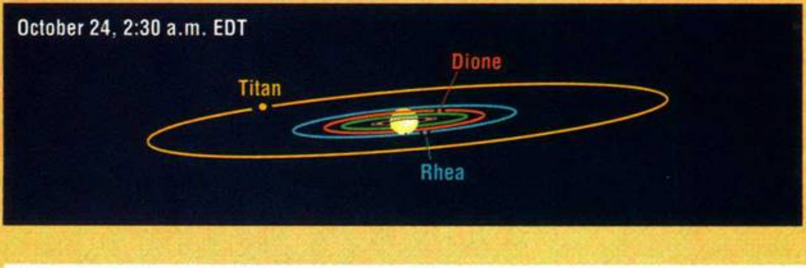
If you've been observing Saturn in a telescope over the past few years, you no doubt have noticed that its rings have been getting closer to edge-on. Approximately every 15 years, the plane of the rings tilts edge-on to our line of sight. Because the rings are so thin, when that happens they disappear from view. For several months next year, the familiar Saturn you've grown to know and love will be no more — at least not as seen through a telescope.

But there is another, more subtle though no less fascinating effect that happens as Earth passes through Saturn's ring-plane. Because most of the planet's satellites orbit Saturn in nearly the same plane as the rings, these orbits now are also tilted nearly edge-on to our line of sight. When this happens, the satellites sometimes pass into the shadow of the planet and are eclipsed, or pass in front of or eclipse one another. Although this season of events starts slowly (only two take place this month), by November they will be occurring about once every other day.

Both events this month feature Rhea coming out of Saturn's shadow. The best event for North American observers is on the night of October 23/24. Starting at 5h38m universal time (1:38 a.m. EDT, 10:38 p.m. PDT), Rhea's disk comes out into sunlight. Over the next 14 minutes, Rhea gradually creeps out of Saturn's shadow until it is fully illuminated and shining at magnitude 9.7.







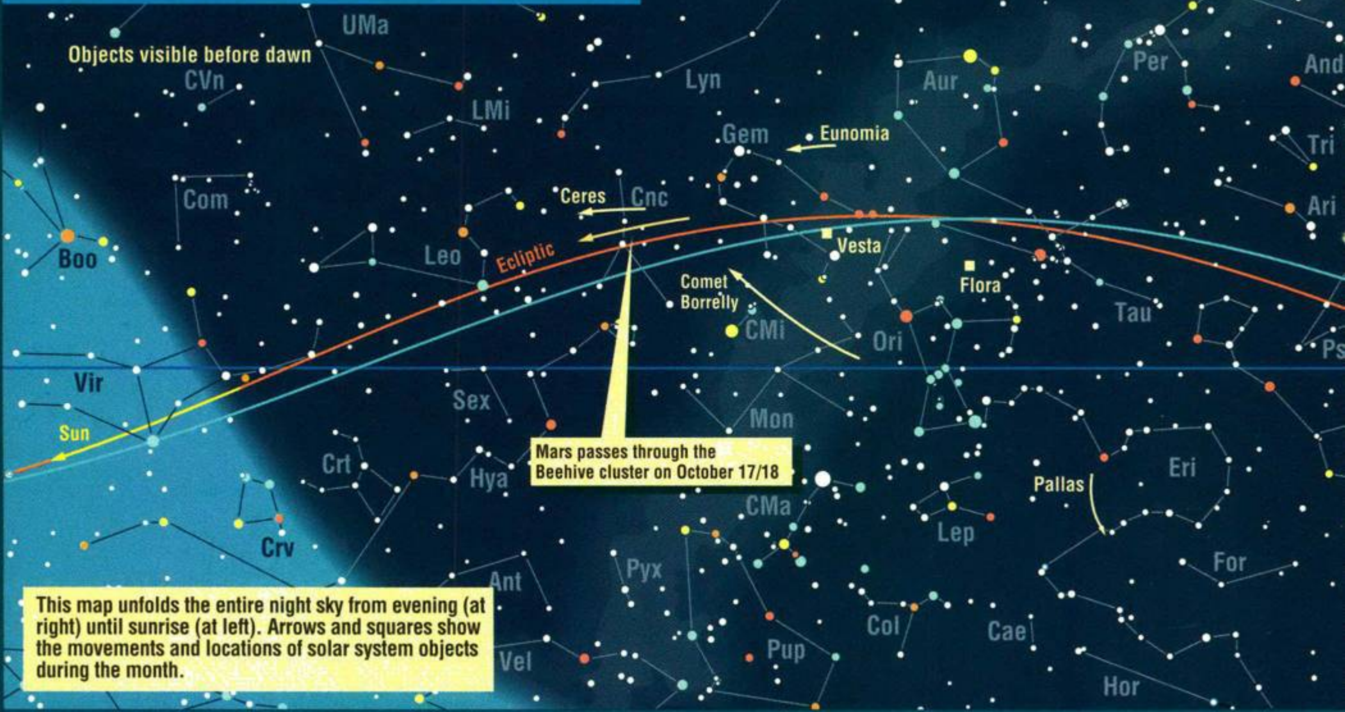
EVENTS OF THE SATURNIAN SATELLITES

Date	Begin Time	End Time	Event	Type of Event
October 24	5h38.2m	5h52.1m	Saturn eclipses Rhea	Reappearance
October 28	18h12.2m	18h24.0m	Saturn eclipses Rhea	Reappearance

Begin Time: Universal time at beginning of event. (Subtract 4 hours to convert to EDT, 5 hours for CDT, 6 hours for MDT, and 7 hours for PDT.) **End Time:** Universal time at end of event. **Event:** The nature of the event and the objects involved. **Type of event:** Whether the satellite is reappearing or disappearing.

SKY ALMANAC

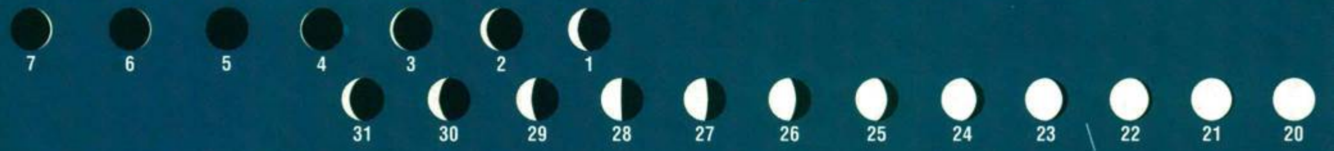
OCTOBER 1994

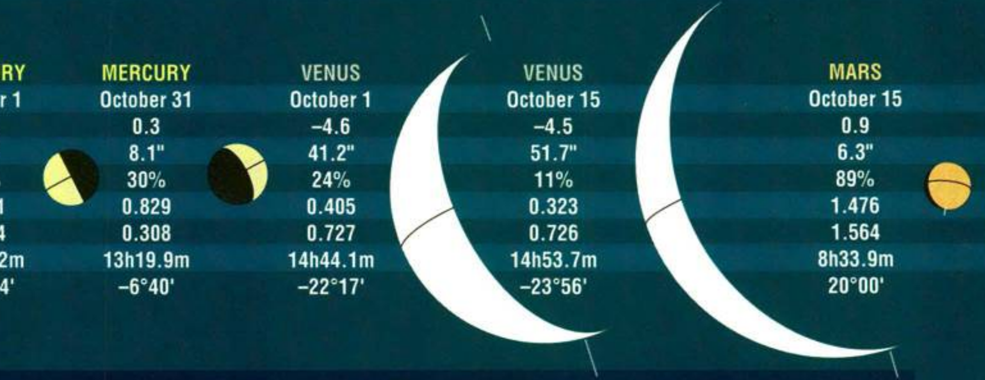

UMa
CVn
LMi
Lyn
Aur
Per
And
Tri
Ari
Gem
Eunomia
Com
Ceres
Cnc
Boo
Leo
Ecliptic
Vesta
Flora
Comet Borrelly
CMi
Ori
Tau
Ps
Vir
Sex
Mon
Sun
Crt
Hya
CMa
Pallas
Eri
Lep
Crv
Pyx
For
Ant
Col
Cae
Vel
Pup
Hor

Objects visible before dawn

Mars passes through the Beehive cluster on October 17/18

This map unfolds the entire night sky from evening (at right) until sunrise (at left). Arrows and squares show the movements and locations of solar system objects during the month.

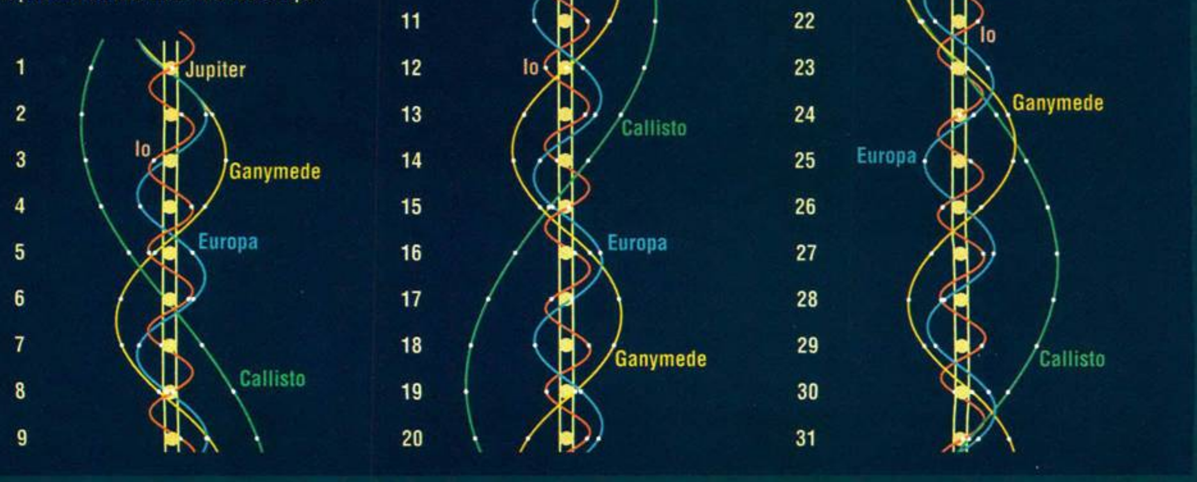

7
6
5
4
3
2
1
31
30
29
28
27
26
25
24
23
22
21
20

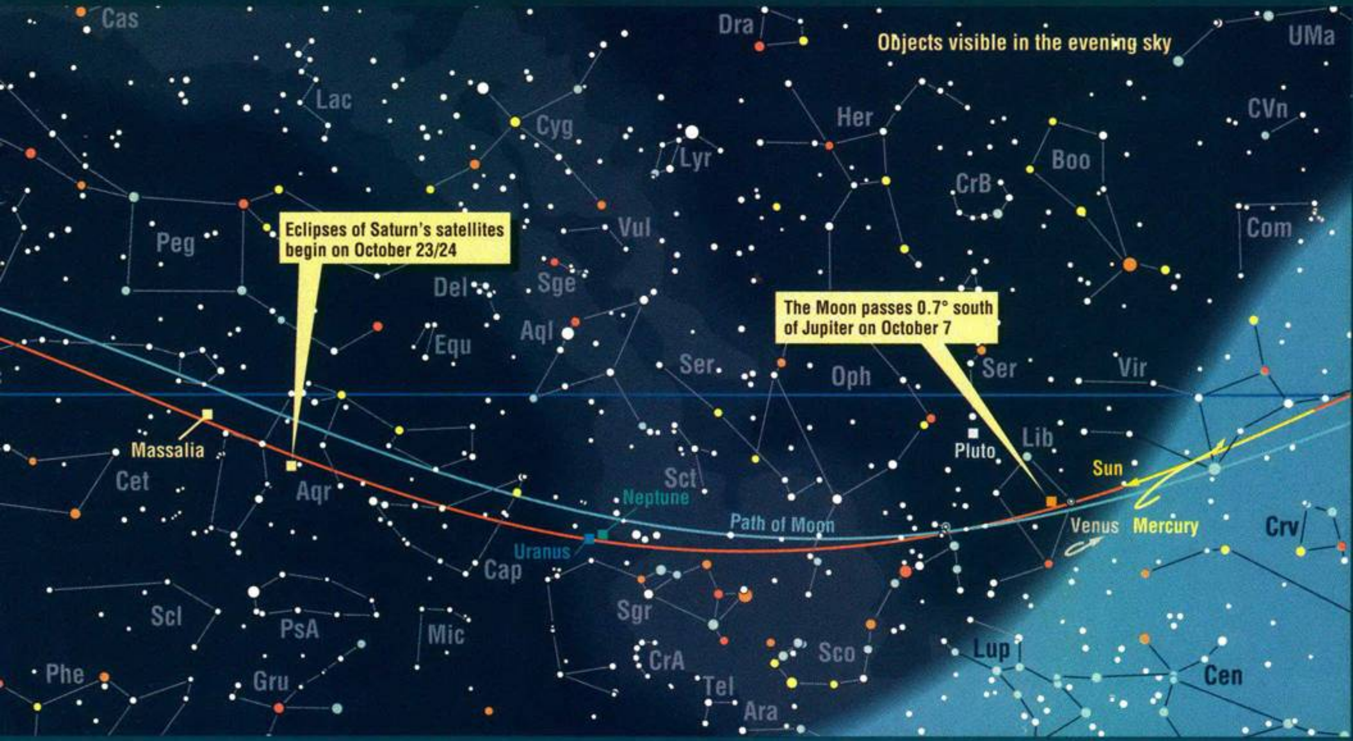


PLANETS	MERCURY	MERCURY	VENUS	VENUS	MARS
Date	October 1	October 31	October 1	October 15	October 15
Magnitude	0.2	0.3	–4.6	–4.5	0.9
Angular Size	7.4"	8.1"	41.2"	51.7"	6.3"
Illumination	51%	30%	24%	11%	89%
Distance (AU) from Earth	0.911	0.829	0.405	0.323	1.476
Distance (AU) from Sun	0.434	0.308	0.727	0.726	1.564
Right Ascension (2000.0)	13h59.2m	13h19.9m	14h44.1m	14h53.7m	8h33.9m
Declination (2000.0)	–15°34'	–6°40'	–22°17'	–23°56'	20°00'

JUPITER'S MOONS

Dots display positions of Galilean satellites at 8 p.m. EDT on date shown. South is at top to match the view in a telescope.

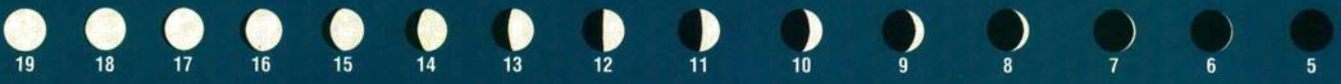


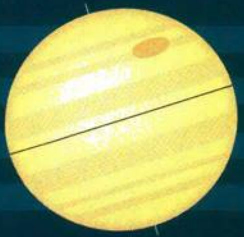

Objects visible in the evening sky
Cas
Dra
UMa
Lac
Cyg
Lyr
Her
CVn
Boo
CrB
Com
Peg
Vul
Del
Sge
Aql
Equ
Ser
Oph
Ser
Vir
Massalia
Cet
Aqr
Sct
Neptune
Pluto
Lib
Sun
Uranus
Path of Moon
Venus
Mercury
Crv
Cap
Scl
PsA
Mic
Sgr
CrA
Sco
Lup
Cen
Phe
Gru
Tel
Ara

Eclipses of Saturn's satellites begin on October 23/24

The Moon passes 0.7° south of Jupiter on October 7

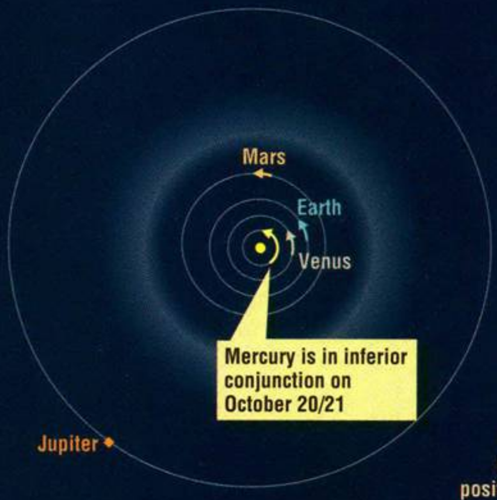
To locate the Moon in the sky, draw a line from the phase shown for the day straight up to the curved light-blue line.


19
18
17
16
15
14
13
12
11
10
9
8
7
6
5

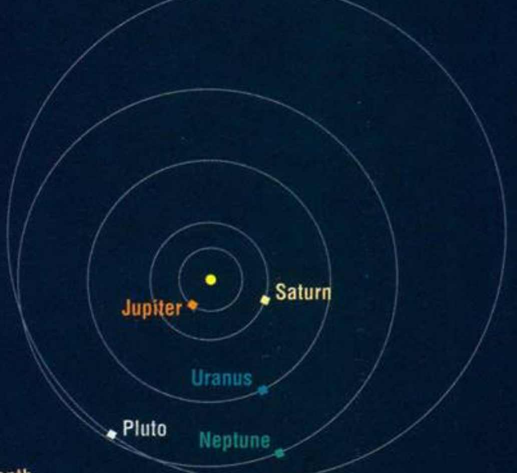


JUPITER	SATURN	URANUS	NEPTUNE	PLUTO
October 15	October 15	October 15	October 15	October 15
−1.7	0.7	5.8	7.9	13.8
31.4"	18.4"	3.6"	2.2"	0.1"
100%	100%	100%	100%	100%
6.273	8.975	19.636	30.173	30.589
5.399	9.703	19.679	30.175	29.802
15h03.0m	22h35.2m	19h37.7m	19h29.1m	15h49.8m
−16°23'	−11°02'	−22°04'	−21°16'	−6°22'

THE PLANETS IN THEIR ORBITS

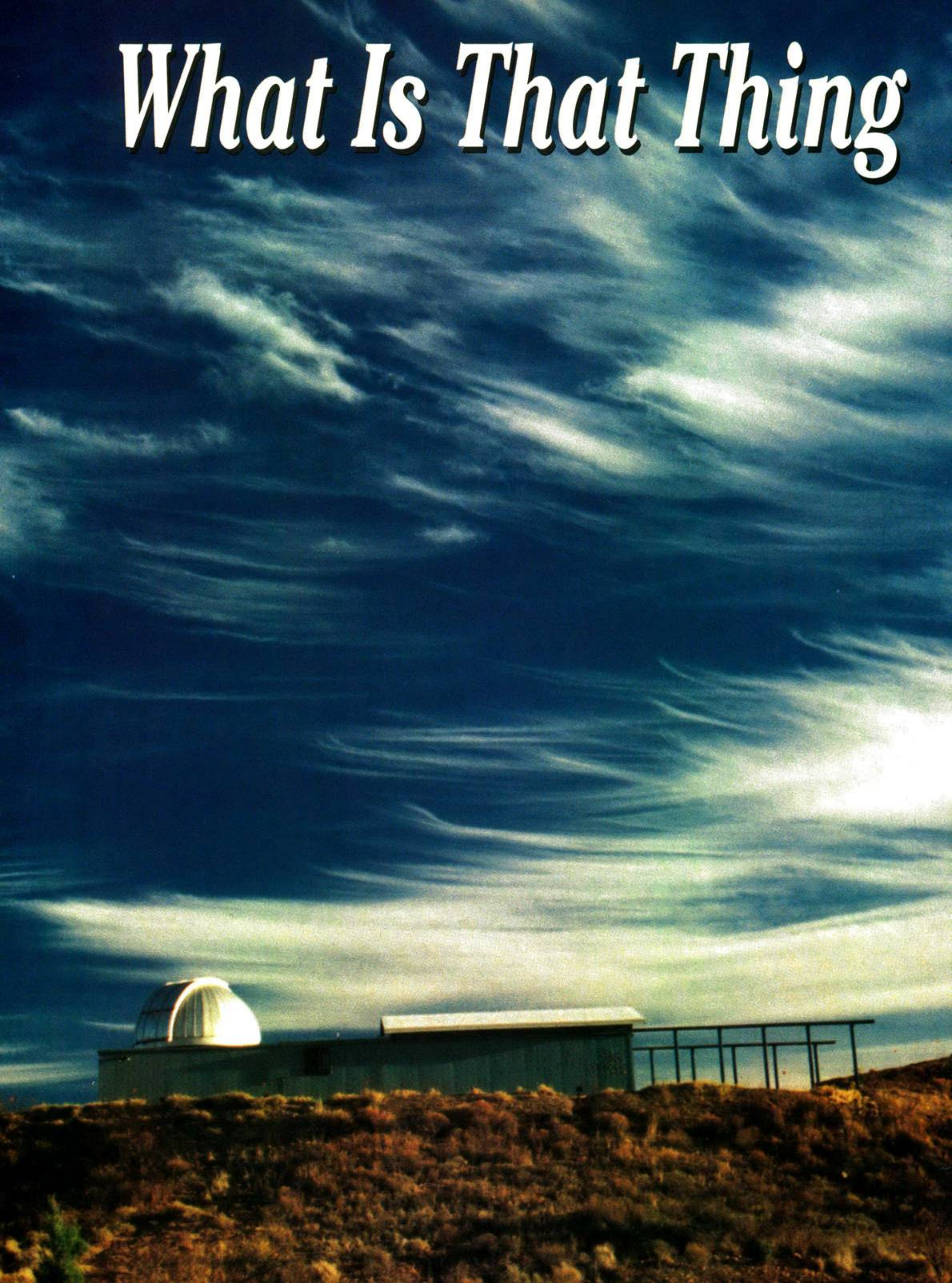

Mars
Earth
Venus
Jupiter

Mercury is in inferior conjunction on October 20/21


Jupiter
Saturn
Uranus
Pluto
Neptune

Arrows and dots represent planets' positions during the month

What Is That Thing



in Your Backyard?

Five readers share observatory designs that keep scopes handy yet unobtrusive enough that the neighbors don't complain.

by David Bruning

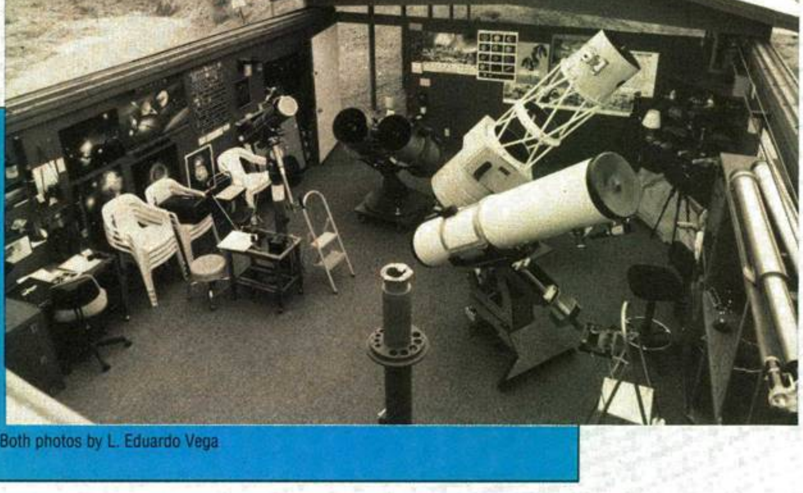
The February 1994 Letters column contained a request for a story about observatory designs. Our reply invited readers to send photos of their observatories, and over two dozen responded. At first glance, most looked like ordinary home observatories with roll-off roofs. But further inspection revealed some innovative features that we couldn't resist sharing. We'll start the tour with the ultimate backyard observatory.

Having It All

Eduardo and Patricia Vega built their dream observatory about five years ago near Benson, Arizona, 40 miles east of Tucson. The out-of-town site provides dark skies and excellent seeing most of the year. The observatory has three rooms: a 20' by 20' domed observing room holding a 20-inch Maksutov-Cassegrain, a 20' by 27' room with a roll-off roof and five scopes, and a heated room with a kitchenette, bathroom, and sofa bed.

The observatory rooms have red lights controlled by dimmers, low-wattage white ones for normal activities, and high-wattage white ones for working on equipment. Indoor-outdoor carpets cover the floors for comfort and for cushioning an eyepiece in case it falls. The walls have four-outlet fixtures every 4' to 6' and the pier has its own four-outlet fixture. Vega says, "You'll never imagine the number of outlets you'll need." Additional conduit runs between the pier and a wall to carry future cables for computers and CCD cameras.

Many of the scopes were built by Max Bray of Phoenix, Arizona, who contributed his telescope-making talents so children can learn to love the sky. In furthering that goal, the Vegas open their observatory to school groups and Boy Scout troops, as well as assorted adult educational groups and clubs, including the Tucson Amateur Astronomical Association.



TWO OBSERVATORIES IN ONE — the observatory of Eduardo and Patricia Vega has a dome holding a 20-inch Maksutov-Cassegrain and a room with a roll-off roof that contains five scopes. To share their love of astronomy, the Vegas open this marvelous observatory located outside of Tucson, Arizona, to local clubs and school groups.

Both photos by L. Eduardo Vega

Krick with a Twist

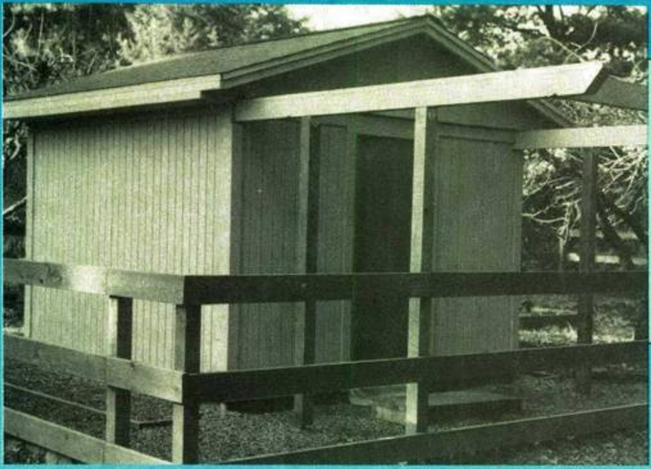
Gary Eklund of West Linn, Oregon, used Jim Krick's basic design ("Building Owl Observatory," April, May, and June 1992) for his roll-off roof observatory. Instead of using cross braces for the roll-off rails as Krick did, however, Eklund tied the posts into a fence for easier access to the door.

Instead of a metal roof, the local homeowner's association required an asphalt-shingled one that increased the weight significantly. One person can't easily move the roof, so Eklund installed two boat-trailer winches, one for opening the roof and the other for closing it.

The joy of having an observatory, according to Eklund, is how quickly he can observe. Everything is set up and ready to go so he can take advantage of even half-hour periods to observe variable stars for the American Association of Variable Star Observers.

PVC-Pipe Dome Guide

Because he lives on a flood plain, William Freeman of Gretna, Louisiana, built his domed observatory on 4x4 pilings. The walls are 4' high and made of plywood. The dome is 9' in diameter and rolls on 28 roller casters. PVC pipe formed in a circle acts as a guide for the casters. Freeman used plywood to frame the dome and its 2' slotted opening. Masonite covers the frame



THIS SPACE HUT is a spin-off from the Owl Observatory series (April, May, and June 1992.) Gary Eklund used a shingled roll-off roof instead of Owl's metal one. The added weight requires boat trailer winches to open and close the roof. The fence adds support to the roof rails but allows easy access to the door.

Gary Eklund

and a layer of fiberglass weatherproofs the dome. Masonite is fragile, so Freeman installed an aluminum strip along the bottom to keep it from breaking.

The dome has two doors, or shutters, that cover the opening. The bottom one comes off for observing objects low in the sky. The top door folds back on a piano hinge to allow observing near the zenith. Closing one of the doors while observing helps shield the light from nearby street lamps.

Freeman proves one doesn't need to be a skilled carpenter to build a great-looking observatory. He's a truck mechanic and says, "The best thing I've ever built is my observatory."

Garden Patio

Venting heat from the hot Florida sun was a concern for Don Trombino of Deltona. A roll-off roof became the major design element of his 12' by 14' solar observatory, which holds a 6-inch f/12 refractor. Vents high in the north and south walls and at the base of all four walls keep the observatory cool when the roof is closed. Walls of white masonite (similar to those in shower stalls) and indoor-outdoor carpeting reflect the Sun's heat when the roof is open.

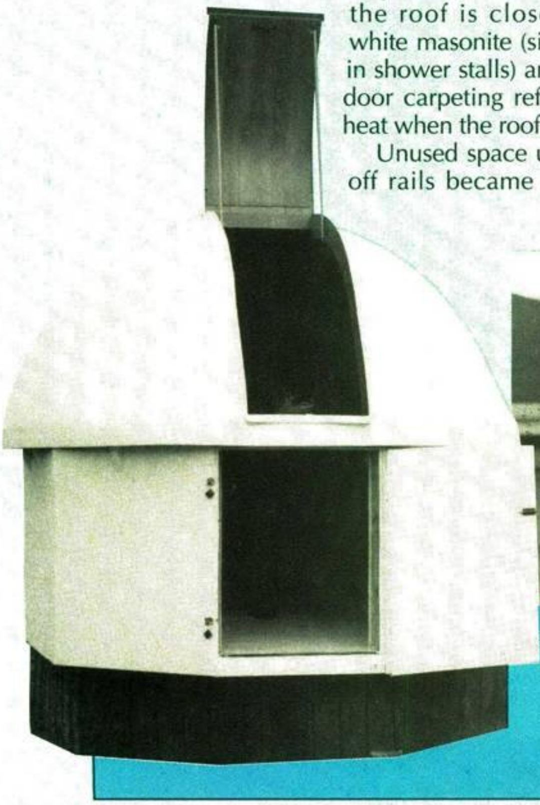
Unused space under the roll-off rails became a patio, with nylon screening between the rails providing shade for plants and visitors when the roof is closed. A Formica counter inside the observatory extends the length of the south wall. Kitchen cabinets above and below the counter store cameras, eyepieces, solar filters, and observing notebooks. With the patio and all concrete work, the observatory cost about $4,700.

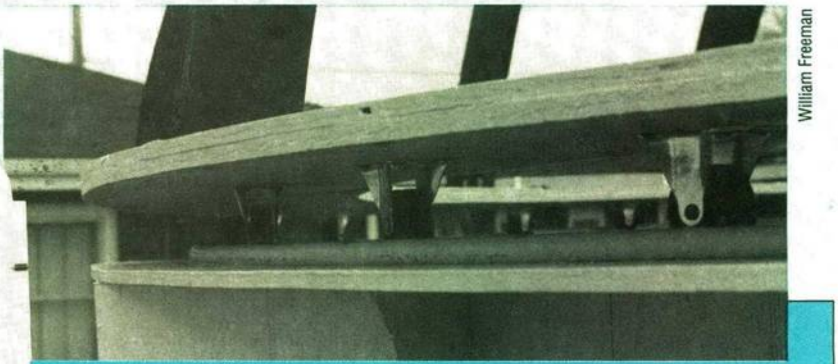
County zoning officials had no regulations concerning observatories, but Trombino had to follow strict building procedures in this hurricane-prone area. He says that commercial builders were of little help when it came to constructing a moving roof. "Local backyard astronomers, especially those with construction experience, know all the tricks of the trade."

Lightweight Roof

After 10 years, the cypress-wood walls and plywood roof of Ron McClung's original observatory gave in to the weather. An aluminum shed company custom cut the panels and made a door for his new observatory in Melbourne, Florida. Instead of fighting termites for a plywood floor, McClung uses tamped dirt covered by indoor-outdoor carpeting.

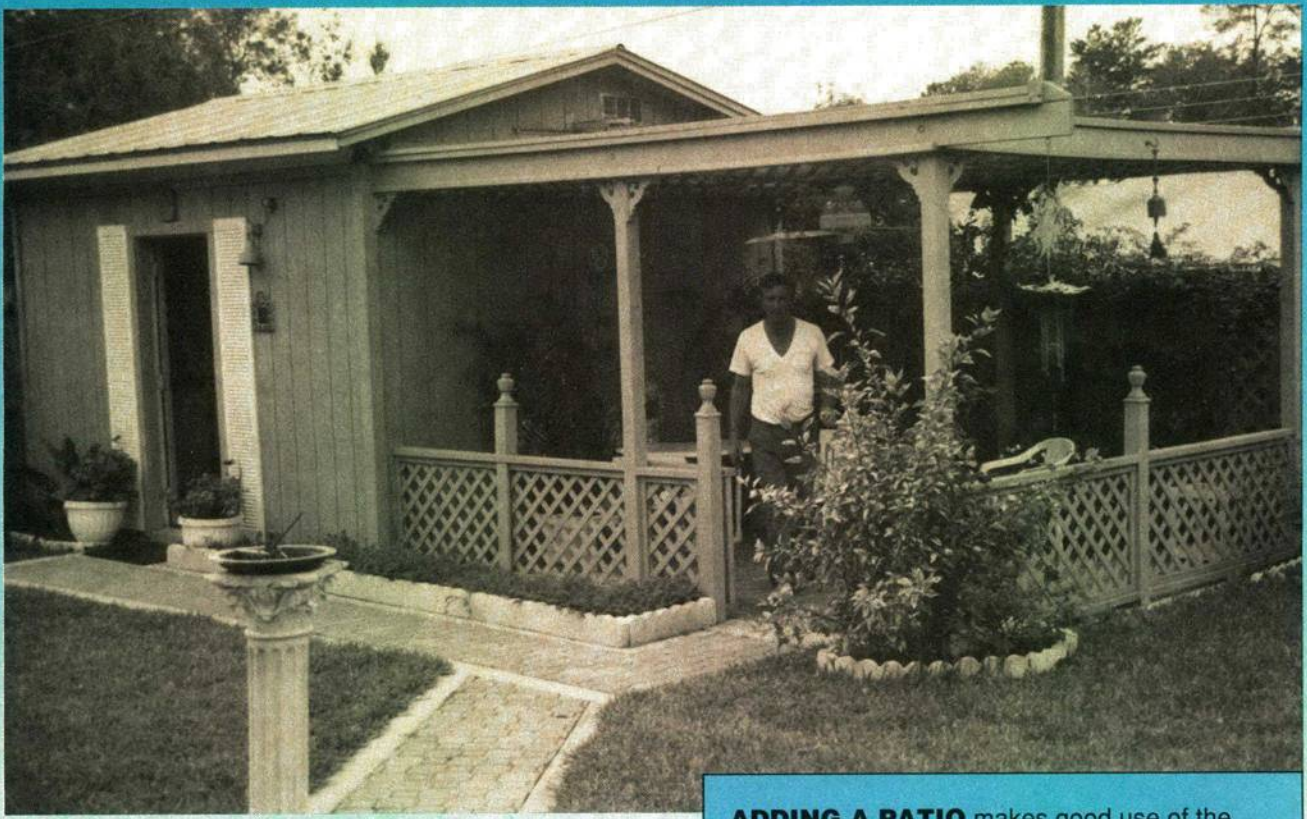
The absence of winter means he can use a lightweight roof that easily slides off by hand. The observatory had roll-off rails, but McClung and his wife frequently bumped their heads on them while doing yard work. Now he fits a T-shaped support made from 2x4s into a 4"-diameter PVC pipe when he slides the roof off. When not in use, a patio stone covers the pipe. For around $400, McClung is again enjoying use of an observatory in his backyard.





William Freeman

KEEP 'EM ROLLING is the job of the PVC pipe in William Freeman's backyard observatory. It keeps the 28 casters moving in a circle on top of the observatory's 4'-high wall. Two shutters in the 9' dome help shield a scope from the wind and nearby lights.



Don Trombino

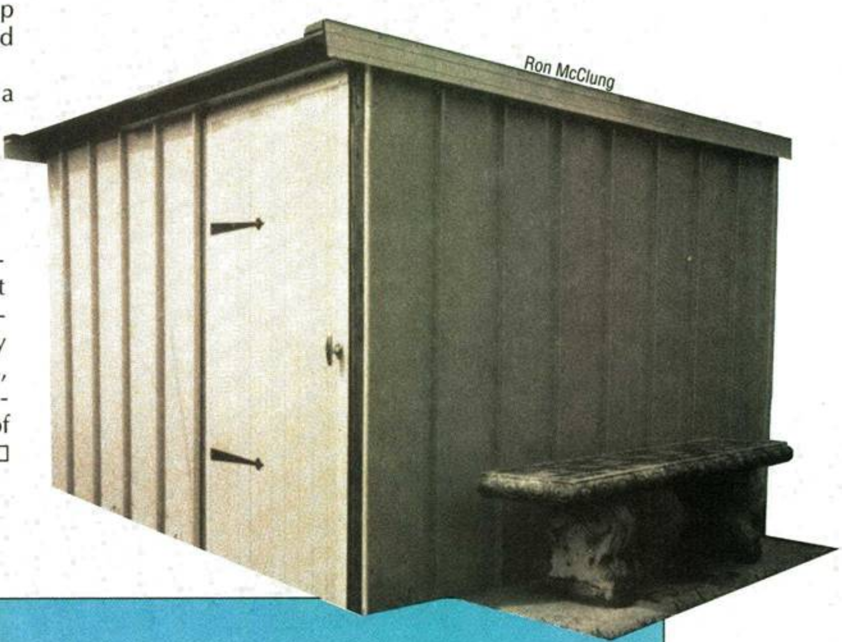
ADDING A PATIO makes good use of the space under the roll-off rails of Don Trombino's observatory (patio designer Wayne Meehan is shown). The roof covers the patio when the observatory is open, and nylon screening between the rails provides shade when the observatory is closed.

Before Starting an Observatory

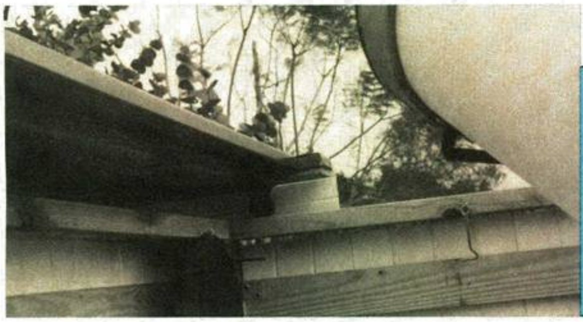
Readers also shared some practical tips on steps to take before beginning construction. Communities treat observatories in different ways regarding building codes, so check with the local building inspector before starting one. Let neighbors and local groups look through a scope. Good public relations might help when it comes to getting a permit or variance to build or expand an observatory.

Several readers commented that they had seen a property value go down because of an improperly planned observatory. If the observatory can be used as a garden shed or similarly useful structure by the next owner, then a dream observatory won't turn into a real estate disaster.

Gather the best ideas presented here, add some ingenuity, and you can have a backyard observatory that shields your scope from wind and requires no time-consuming set up. Take pictures of your observatory during construction and send them to Observatories, ASTRONOMY, P. O. Box 1612, Waukesha, WI 53187-1612. Maybe it will appear in our next round-up of great designs. ☐



Ron McClung



NOT AN ORDINARY GARDEN SHED, this one contains a scope instead of a shovel. Ron McClung had a local aluminum shed company custom-build the walls and door for this inexpensive observatory.

ORION
TELESCOPE CENTER

THE WORLD'S LARGEST CATALOG
OF TELESCOPES, BINOCULARS & ACCESSORIES
FOR AMATEUR ASTRONOMERS

Since 1975
America's #1 Source of Superior Telescopes, Binoculars & Accessories

Fast SAME DAY shipping on phone orders received by Noon Pacific Time. Safe *Guaranteed* shipping to anywhere in the USA and Canada!

Call Toll-Free Today For Your Free 100 Page Color Catalog!

Packed with a huge selection of quality telescopes, binoculars and accessories, all at low discount prices! Hundreds of exclusive items you won't find anywhere else.

Only a small selection of our products are in this ad! Be sure you have our catalog.

Call Toll-Free
800-447-1001

Visit One Of Our Three Unique Retail Stores

America's biggest & best selection of telescopes, binoculars & accessories. Now 3 convenient Northern California locations!

San Francisco
1 block from Marina Safeway
3609 Buchanan St., at Bay
415/931-9966

Silicon Valley–San Jose–Cupertino
10555 S. DeAnza Blvd., at McClellan
From Hwy 280 take Cupertino exit, south 1.5 miles on DeAnza, from Los Gatos take Hwy 9 to Saratoga-Sunnyvale Rd.
408/255-8770

Monterey Bay–Santa Cruz
2450 17th Ave., West Marine Building.
From Hwy 1, take Soquel Drive exit, 1/2 block from the freeway at Soquel Avenue
408/464-0465

Some prices in retail stores may vary.

MONEY-BACK
If you are not completely satisfied with your purchase from Orion, for any reason,
100% Satisfaction
Just return it in new condition within 30 days after delivery for a prompt refund.
GUARANTEE

Celestron Ultima 2000 —

The new leader in computer driven Schmidt-Cassegrain telescopes, at Orion now!

Orion is the place to call for the best price and fastest delivery on Celestron's hottest new telescope! At last, a SC telescope that moves quickly and quietly from subject to subject. Much faster, much lighter weight, much easier to use than any other telescope! Revolutionary new mount with roller drive...NO worm gear periodic error! Fantastic easy-to-use controller with huge 10,000 subject database. Completely powered by penlight batteries! Complete information in our new catalog!

$CALL for our low, low price!

Dozens More Telescopes in Our 100 Page Free Catalog!

Orion® Deep Space Explorer™ Dobsonian Telescopes

The best telescope choice in the universe for beginning amateur astronomers!

Featured in an in-depth article in *Astronomy* magazine (12/93) and in the *Sky & Telescope* article "Choosing a Low-Cost Telescope" (12/93). *(Ask for free reprints.)* Find out what the reviewers have been raving about: the Orion Deep Space Explorer telescopes offer the highest-performing complete optical system available!

Ideal for both beginners and advanced astronomers, these great new scopes offer high performance and lasting value. With their fantastic precision ground and polished reflector optical systems, they are ideal for interplanetary, lunar, and deep space observation.

Compare the features to any other telescope: superb hand-figured optics that out-perform similar sized and even larger-sized competitive scopes; a first-rate fully coated Sirius Plössl eyepiece; a quality machined aluminum low-profile helical focuser; low diffraction stay-put secondary support, providing less diffraction than four-vane "spiders" on competitive models; unique counterbalance mounting point; acclaimed smooth-motion Dobsonian mount.

6", 8", 10" and 12.5" Models
Prices Start at $299
Prices include precision helical focuser and 25mm Sirius Plössl eyepiece!

Binoculars for Astronomy

Orion® 8x56 Mini Giants

56mm objective lenses gather over 2.5x the light of ordinary 7x35 binoculars. Perfect for viewing faint celestial objects, daytime viewing. Best Multi-Coated BAK-4 optics. 6° field of view. Standard model 33 oz. Rubber Armored for protection from bumps. Weighs 37 oz.

Standard Model #9504 **$159** (4.71)
Rubber Armored Model #9627 **$179** (5.07)

50mm Explorer™ Binoculars

High performance large diameter binoculars with BAK-4 prisms and multi-coatings. Great for both astronomy and daytime observation. Comfortable ergonomic body design. Include case and straps

7x50 #9306 **$124** (4.44)
10x50 #9308 **$129** (4.44)

Orion 50mm UltraView™

The perfect binocular for eye and sun-glass wearers. Extra-long 23mm eye relief and unique rubber pop-down eye-piece guard allows viewing with or without eye-glasses. Fully multi-coated optics provide high light transmission and maximum contrast compared to standard coated types. BAK-4 prisms. Wide 6.5° field of view. Close focus 16'. Weighs 32 oz. Includes case and straps.

10x50 #9351 **$169** (4.95)
NEW! 7X50 #9357 **$169** (4.95)

Orion 50mm Vista™

Superb for long distance nature observation and astronomy. The image quality will amaze you even when compared to much higher priced binoculars. Fully multi-coated optics provide high-fidelity true color images without ghosting or other aberrations. Long 16mm eye relief and roll-back eyecups for eyeglass wearers. BAK-4 prisms. Weighs just 28 oz. Includes deluxe hard carrying case, rain shield, lens caps, and straps.

10x50 5.3° field of view #9353 **$219** (5.19)
NEW! 7X50 6.0° field of view #9355 **$219** (5.19)

Orion® 70mm FMC Giants

The standard for hand-holdable astronomy binoculars. Fully Multi-Coated. 33% lighter—weighs only 58 oz.—yet the same brightness and 7mm exit pupil as our 11x80 MC model. Superior 'BCF' body design. Includes: soft rubber eyecaps, tripod mounting adapter, durable hard carrying case, lens caps and straps.

10x70 #9501 **$339** (6.97)
14X70 #9494 **$339** (6.97)

80mm FMC Giant Binoculars

20% more light transmission than ordinary "fully coated" binoculars. Fully Multi-Coated optics and superior BAK-4 prisms provide fantastic contrast and greatly improved edge sharpness.

11x80 MC- Brightest, widest field available. Ideal for deep-space observation under dark skies. Hand-holdable. #9502 **$439** (8.05)

16x80 MC- 45% higher power, excellent for astronomy and daytime observation. Tripod recommended. #9496 **$439** (8.05)

20x80 MC-Highest power model perfect for smaller deep-space objects and long range daytime views. Tripod required. #9498 **$439** (8.05)

Orion Standard Series 80mm Giant Binoculars

Made in the same factory as name brand models selling for much more! Fully coated optics with multi-coatings and BAK-4 prisms. Smooth center focus design. Soft rubber fold-back eyecups. Include lens caps, straps, and carrying case.

11x80 model Bright 7.1mm exit pupil, 4.2° field of view #9480 **$299** (7.76)

16x80 model 5mm exit pupil, 3.5° field of view. #9482 **$299** (7.76)

SuperGiant™ 100mm Binos

Gigantic, almost 4" lenses gather 156% of the light of 80mm binoculars. Individual eyepiece focus, fully Multi-Coated optics and BAK-4 prisms. Tripod mounting plate, metal-clad case. Weight 7.5 lbs., height 13.5".

14x100 #9495 **$899** (14.00)
25x100 #9497 **$999** (14.00)
Shipped by FedEx only.

Observing Aids

Eyepiece & Accessory Cases

With patented unbreakable latches, die-cut foam inserts. (Inside Dimensions shown)

Small Case (shown) 11"x7"x3" #5951 ***$17.95*** (2.78)
Medium Case 12.5"x9"x5" #5952 ***$26.95*** (3.36)
Large Case 16"x11"x5" #5953 ***$49.95*** (5.19)

Orion® FlexiShield™ Dew Caps

Forms into a tube with Velcro closure, opens flat for storage and travel. Models to fit most telescopes.
8" Celestron/Meade SC #4200 ***$44.95*** (2.98)

Other sizes available for scopes 3.5" to 14" —See our catalog for details

Orion® Dew Zapper

Gently replaces lost heat, a sure-fire cure for dew problems.

8" Dew Zappers—fit all Meade & Celestron 8" SCs DC #3503, AC #3504 ***$47.95*** (2.98)
10" Dew Zappers—fit all Meade 10" SCs DC #3506, AC #3508 ***$54.95*** (2.98)
11" Dew Zappers—fit all Celestron 11" SCs DC #3510, AC #3512 ***$59.95*** (2.98)

Scope Saver Telescope Covers

Keep the dust and dew away with these waterproof nylon covers; drawstring closure with cord lock.

8"Model #15130 ***$33.95*** (2.43)

10"-11" Model Fits Meade 10" and Celestron 11" #15131 ***$39.95*** (2.43)

Now available for Deep Space Explorers! Ask about other sizes.

Observer's Chairs

Standard Model—Adjustable height center column and padded seat. #5935 ***$39.95*** (4.70)
Deluxe Model—Built for professional musicians. Extra heavy duty. #5934 ***$89.95*** (8.02)

Night Vision Flashlights

An essential accessory for astronomers. Choose from our wide selection.

Nitewriter Pen #5709 ***$8.95*** (1.79)
Hands-Free Flex Light #5707 ***$17.95*** (2.43)
Starlite LED Flashlight #5714 ***$24.95*** (2.43)
Celestron LED Flashlight #5720 ***$21.95*** (2.43)

Filters

Glass Solar Filters

High-quality optical glass filters, for superb images of the sun with your telescope. Triple-coated with advanced scratch-resistant stainless steel alloy. Great for both visual and photographic use. Slide fits over the front of your telescope.

For 8" SCs #7713 ***$144*** (4.05)
For 10" SCs #7715 ***$162*** (4.05)

NEW! *Solar glass filters for Deep Space Explorer reflectors. Many other sizes available—see our free catalog for details.*

Moon Filters

Cuts 87% of the light from the Moon. Reduces glare by uniformly reducing light transmitted over the entire spectrum.

.965" #5664, **1.25"** #5662 ***$15.95*** (2.43)

Color Eyepiece Filters

Made from absolutely the highest quality photographic-grade precision-ground optical glass, anti-reflection coated. Ideal for contrast-enhancing planetary and lunar observations and photography with any telescope. The black anodized, machined aluminum cells thread into any standard eyepieces, or into our universal camera adapters.

.965" Basic Set of 4 Filters #80A Blue, #58 Green, #25 Red, #15 Yellow. #5510 ***$46.95 set*** (2.98)
1.25" Basic Set of 4 *#80A Blue, #58 Green, #25 Red, #15 Yellow.* #5514
1.25" Expansion Set of 4 *#21 Orange, #47 Violet, #11 Yellow-Green, #82A Very Pale Blue.* #5516
1.25" Advanced Set of 4 *#8 Light Yellow, #23A Light Red, #38A Deep Blue, #56 Light Green.* #5570
$54.95 each set (2.98)
Deluxe Set of 8 Filters for 1.25" Includes all the filters in our basic and expansion filter sets. #5517 ***$99.95 set*** (3.45)
Full Set of 12 Filters for 1.25" Includes Basic Set, Expansion Set, Advanced Set. #5575 ***$145 set*** (3.67)
2" Set of 4 Includes #80A Blue, #58 Green, #21 Orange and #12 Yellow. #5513 ***$89.95 set*** (2.98)
Individual .965", 1.25" & 2" Filters- Many colors available, see our catalog for details.

SkyGlow™ Light Pollution Filters

The finest available, SkyGlow™ filters from Orion make detailed deep-sky observing possible from light polluted city and suburban locations. Sophisticate multi-layer technology actually absorbs light pollution! Greater blocking and higher transmission than competitive models. See catalog for details..

SkyGlow UltraBlock Filters–
Visual Only
For severely light polluted areas and faint nebulae.

1.25" UltraBlock Filter–fits 1.25" eyepieces. #5654 ***$99.95*** (3.45)
2" UltraBlock Filter–fits 2" eyepieces. #5657 ***$149*** (3.67)
.965" UltraBlock Filter–fits .965" eyepieces. #5655 ***$79.95*** (3.67)
SC UltraBlock Filter–fits rear cell of Meade & Celestron SC scopes. #5656 ***$149*** (3.67)

SkyGlow Broadband Filters—Photographic and Visual
For use in slight to moderately light polluted areas.

1.25" Broadband Filter–fits 1.25" eyepieces. #5660 ***$79.95*** (3.45)
SC Broadband Filter–fits rear cell of Meade & Celestron SC scopes. #5658 ***$99.95*** (3.45)
52mm Broadband Filter–For 52mm camera lenses. (Adapter rings available for other diameters.) #5668 ***$87.50*** (3.45)
2" Broadband Filter–fits 2" eyepieces. #5659 ***$119*** (3.45)
.965" Broadband Filter–fits .965" eyepieces. #5661 ***$49.95*** (2.98)

Accessories

Call Toll-Free For Our Huge 100 Page Catalog and See Even More!
Orion Accessories are absolutely guaranteed to be the finest quality available. Compare them side-by-side with "famous name" products! We buy direct from many of the same sources, always specify the highest quality, and pass along the savings to you! 100% satisfaction guaranteed!

Universal Camera Adapters

For prime focus or eyepiece projection astrophotography.
.965" #5268 **$27.95** (2.98)
1.25" #5264 **$29.95** (2.98)
Hybrid 1.25"/.965" #8782 **$29.95** (2.98)

Variable Power Camera Adapter

Allows variable projection distances during eyepiece projection photography. For 1.25" eyepiece holders.
#5262 **$39.95** (2.98)

Orion Slow Motion Adapter

Attaches to your photo tripod pan head. 2 slow motion control knobs to make precision adjustments in altitude and altazimuth. Very handy for tracking planets, the Moon, etc. with refractor telescopes and small spotting scopes. Attaches with a standard 1/4-20 thread.
#7012 **$59.95** (2.98)

Extension Cable for Slow Motion Control

12 3/4" flexible cable, for tracking at high powers. Buy 2, one for each axis.
#5014 **$17.95 ea.** (2.43)

Tele-Extenders for SC Scopes

For high powered photography with your Meade, Celestron 4", 8", 10", 11", 14" Schmidt-Cassegrain.
Standard Tele-Extender #5125 **$29.95** (2.98)
Variable Tele-Extender #5127 **$39.95** (2.98)

T-Adapters for SC and MAK

Threads to rear cell of telescope, requires t-ring for your camera model.
for SC #5116 **$26.95** (2.98)
for C-90 #7115 **$29.95** (2.98)

T-Rings for all 35mm Cameras

Available for many different camera types, call toll-free or see our catalog for your particular model.

45° Erect Image Diagonal Prisms

See the world as it really is with Orion's 45° erect image diagonal. Ideal for all refractors and compound telescopes used for terrestrial viewing.
1.25" Diagonal #8790
.965" Diagonal #8791
Hybrid 1.25"/.965" Diagonal #8792
$44.95 (3.45)

90° Star Diagonal Prisms

Orion's multi-coated diagonals let you view at a right angle from the direction your telescope is pointing. The image is backward. Ideal for refractors and Schmidt-Cassegrains used for astronomical viewing.
1.25" Star Diagonal #8763 **$49.95** (2.98)
.965" Star Diagonal #8761 **$29.95** (2.98)
Hybrid 1.25"/.965" Star Diagonal #14008 **$33.95** (2.98)

Orion Ultra™ 2" Diagonals

Your SC or refractor deserves the finest. Both models are the finest optical quality and use the best coatings available.
2" Prism Diagonal–Absolutely the finest quality multi-coated 2" prism for highest light transmission.
For refractors #8770
For Schmidt-Cass. #8771 **$219** (4.71)
2" Mirror Diagonal– Affordable, high-quality first-surface optical flat star diagonal.
For refractors #8773
For Schmidt-Cass. #8772 **$109** (3.45)

Sky Wizard™

Electronic Finder & Sky Catalog

Let Sky Wizard do the work, while you relax and have fun observing!

- Find any celestial subject in 15 seconds!
- One minute setup — no polar alignment or levelling.
- Observe hundreds of objects in a few hours!
- For ANY telescope, with or without a motor drive. *Even altazimuth or Dobsonian scopes!*
- Digital display of celestial coordinates (RA & Dec).
- Built-in electronic sky catalog — find subjects by their common catalog name, not their coordinates. Complete with object descriptions.
- Powered by a single 9v battery. Weighs just 6 oz!

SAVE $50 On Any Sky Wizard when purchased with any telescope installation package!

Sky Wizard Model 1
Includes the Messier Deep Space Catalog of 110 objects, 28 bright stars, and the planets. #7801 **$199** (4.11)

Sky Wizard Model 2
Huge 2100+ object database, plus a user catalog to store 27 objects of your choice. #7802 **$319** (4.44)

Sky Wizard Model 3
Gigantic 10,000 object database, expanded subject descriptions, RS-232 port. #7803 **$469** (6.78)

Complete system requires Sky Wizard Model 1, 2 or 3 and a telescope installation package, sold separately.

Installation Packages
Includes 2 encoders, all required mounting hardware and brackets, connecting cables, and complete illustrated instructions.
Installation packages are available for most telescope models. Call for details.
starting at **$177** (5.29)

Encoders and cables also available separately for custom installations. Call for details.

Orion Off-Axis Guider

Allows you to observe a guide star during photography. Multi-coated.
#5144 **$74.95** (3.45)

Orion UltraGuider

Wide-range lateral prism adjustment; precision helical focusing; adjustable camera focal plane position.
#5139 **$129** (4.19)

110v Motor Drive for Refractors

Fits Orion equatorial mounts, many others. Plugs into any standard AC outlet.
#17001 **$74.95** (3.95)

12 Amp Hour Porta Pac Battery

Ideal for high power-consuming accessories. With carrying case. Weighs only 10 lbs.
#2354 **$109** (8.97)

Eyepieces

See Our Huge 100 Page Catalog for Many More! Including a Fantastic Selection of Name Brand Eyepieces!
2
3b
3c
3a
5
1
New!
40mm
✧Sirius™
Plössl

1 ✧ *Sirius*™ *Plössl 1.25" Eyepieces*

Fantastic Name-Brand Quality Eyepieces at an Incredible Low Price!

You could pay nearly twice the price for "famous name" Plössl eyepieces, but we don't think you'll be able to tell the difference if you compare them to these fantastic eyepieces!

Sirius Plössls are top-quality, 50° apparent field (43° 40mm) eyepieces with extremely sharp images of impressively high contrast. Ideal for all types of telescopes. The Classic 4-element Plössl design is renowned for its fantastic performance and has become the standard by which all other eyepieces are compared.

The Fully Magnesium fluoride coated optics are mounted in precision black anodized aluminum housings with chrome-plated brass 1.25" barrels for durability and precision fit.

25mm #8530, *17mm* #8531, *10mm* #8532, *7.5mm* #8533 **$57.95 ea.** (3.45)
New! *40mm* #8529 **$79.95** (3.67)
Case only #5911 **$12.95** (2.19)

SPECIAL OFFER–Buy Two or More and Save!

- *Any 2 .... $10 off (Save $5 ea.)*
- *Any 3 .... $30 off (Save $10 ea.)*
- *Any 4 .... $60 off (Save $15 ea.)*
- *ALL 5 .... $85 off (Save $17 ea.)*

*Bonus—**Free case** with purchase of 2 or more!*

2 Orion 5-Element Ultrascopic™ Eyepieces

With superb Ultra™ Multi-Coatings!

Made for Orion by Japan's finest lens maker, Ultrascopic eyepieces yield the highest contrast, greatest light transmission, and best overall image fidelity obtainable. With a superior 5-element design and Ultra™ Multi-Coatings on *every* surface, they achieve a level of performance "name brand" 4-element models can't match. Wide 52° flat field of view. Removeable coutoured rubber eyeguard. The 5mm and 3.8mm feature advanced 7-element designs which yield surprisingly long eye relief. Absolutely guaranteed to knock your socks off!

Medium-High Power 5-element
20mm #8566, **15mm** #8568, **10mm** #8570, **7.5mm** #8572 **$89.95 ea.** (3.45)

Wide Field 5-element **25mm** #8564 **$99.95** (3.45)
30mm #8562, **35mm** #8560 **$119 ea.** (3.45)

High Power 7-element *—Long Eye Relief*
5mm #8574, **3.8mm** #8576 **$99.95** (3.45)

3 Orion Explorer™ Multi-Coated 1.25" & .965" Eyepieces

These fine quality multi-coated eyepieces offer great performance at Orion's low direct-discount price. Three different optical designs are incorporated, to maximize efficiency in the various focal lengths. Black anodized, internally blackened, threaded for filters (except 40mm .965").

b *1.25" Orthoscopic*
5mm #8500, **7mm** #8502, **9mm** #8504, **12.5mm** #8506, **18mm** #8524, **25mm** #8526
$57.95 each (2.98)

c *1.25" Kellner*
6mm #8536, **9mm** #8538, **12mm** #8540, **18mm** #8508, **25mm** #8510, **40mm** #8512
$47.95 each (2.98)

a *.965 Orthoscopic*
5mm #8580, **7mm** #8581, **9mm** #8582, **12.5mm** #8583 **$49.50 each** (2.98)

a *.965 Kellner & Achromatic Huygenien*
K 18mm #8584, **K 25mm** #8585, **AH 40mm** #8586
$37.50 each (2.98)

Illuminated Reticle Eyepieces

A necessity for long exposure astrophotography and very useful for polar alignment.

12.5mm Plössl Illuminated Reticle 1.25"
Illuminator has fully adjustable brightness. Features double crossline reticle. Batteries included.
#8484 **$119** (3.45)

9mm Orthoscopic Illuminated Reticle 1.25"
Adjustable brightness illuminator. 'Bull's-eye within crosshairs' reticle. Needs 2 SR-44 batteries, not included.
#8488 **$129** (3.67))

12mm Kellner Illuminated Reticle 1.25"
Features double crossline reticle and red LED illuminator. Plugs into power panel drive bases.
#8482 **$74.95** (3.45)

12mm Kellner Illuminated Reticle 1.25"
Same as 8482 above except has a wireless illuminator. Needs 2 SR-44 batteries, not included.
#8481 **$99.95** (3.45)

SR-44 Batteries (pkg. of 2) #2360 **$5.95** (1.79)

5 UltraZoom™ 7–21mm

The finest zoom you can buy for your 1.25" telescope. For astronomy or terrestrial observing. 65°-35° field. Fully coated.
#8556 **$179** (3.67)

Barlow Lenses

Orion offers a large selection of barlow lenses, allowing you to double or even triple the power of your eyepieces, maximizing the versatility of your collection. Available in .965", 1.25" and 2" diameters.

Fully Baffled 2x Barlow
Multi-coated, with internal baffling to block transmission of stray light. Premium performance at a remarkable price.
.965" #8740 **$39.95** (2.98)
1.25" #8746 **$46.95** (2.98)
2" #8724 **$89.95** (3.95)

Ultrascopic 2x Fully Multi-Coated Barlow
3-element Ultrascopic lens for superior images and precise color correction. Fully multi-coated optics, black anodized barrel. 1.25 barrel.
#8750 **$64.95** (3.45)

VariPower 2-3x Barlow
Allows you to adjust the magnification factor of the barlow by sliding the internal cell along a calibrated scale. Fully multi-coated optics. 1.25" barrel.
#8748 **$59.95** (3.45)

Shorty Barlows **Sale!**

The short bodies allow extra versatility: provides 2x magnification when the eyepiece is inserted directly, and 3x magnification when positioned before the diagonal on a refractor or SC. Will work in all telescopes, including those where longer barlows won't work.
.965" #8710 **$44.95** (2.98)
1.25" #8711 **$54.95** (3.45)

Quality Components for Building or Upgrading

Parabolic Primary Mirrors

Excellent hand-figured parabolic mirrors guaranteed to meet theoretical limits of resolution. Fine polished, coated twice: with Aluminum and Silicon monoxide. Very competitively priced! *See catalog for pricing.*

Standard Primary Mirrors
Made from fine soda-lime plate glass, 1:8 thickness ratio. Guaranteed 1/8 wave. Sizes: 6" f/8, 8" f/6, 10" f/4.5, 12.5" f/6.

Pyrex Low Expansion Mirrors
Made from fine annealed Pyrex brand low expansion glass, 1:8 thickness ratio. Guaranteed 1/10 wave. Available with standard or 94% reflectivity Enhanced Aluminum coatings. Sizes: 6" f/5, 6" f/8, 8" f/6, 10" f/4.5, 10" f/6, 12.5" f/6.

Elliptical Secondary Mirrors

Made from fine annealed Pyrex brand glass, aluminized and SiO overcoated. Guaranteed 1/10 wave accuracy. Available with standard or high reflectivity Enhanced Aluminum coatings. Nine sizes from 1.00 to 4.00" minor axis.
See catalog for pricing.

6x30 Achromatic Finder Scopes

6x30mm—Same unit used on $1000+ "big name" telescopes. With 2-ring metal bracket, fits scopes 6"-12".
#13023 (white) **$49.95** (3.41)

6x30mm Right Angle—90° prism for right-angle viewing. Includes bracket.
#13021 (white) **$74.95** (3.41)

Large Aperture Finder Scopes

These are high-quality finders at incredibly low prices! Fully coated wide field achromatic optics with adjustable focus. Precision crosshairs. White or black enameled metal tube. (Mounts sold separatly.)

8x50mm—2.7x light grasp of 30mm models. Bright 6.25mm exit pupil.
#7090 (white) #7094 (black) **$69.95** (3.41)

8x50mm Illuminated—Wireless illuminator with adjustable brightness.
#7092 (white) #7096 (black) **$99.95** (3.41)

9x60mm — 44% more light grasp than 50mm models.
#7091 (white) #7095 (black) **$99.95** (3.41)

9x60mm Illuminated—Wireless illuminator with adjustable brightness.
#7093 (white) #7097 (black) **$139** (3.41)

Superb Dovetail Aluminum Mounts for 50mm and 60mm Finder Scopes

Instantly install or remove your finder, without tools, without disturbing alignment! Black anodized, Fits any scope 6" and over including Celestron & Meade SCs. *(pictured above)*
8x50mm bracket #5040 **$37.50** (2.45)
9x60mm bracket #5041 **$44.50** (2.98)

Low-Profile Helical Focusers

Economical yet precise focusing. Ideal for fast optical systems. Cast aluminum base with threaded machined aluminum inner tube.
1.25" #13014 **$39.50** (2.45)
2.0" #13016 **$59.50** (2.98)

Rack-and-Pinion Focusers

Finest in their class! Diagonal-cut plated brass racks, oversized knurled knobs, long focus travel.
1.25" #13007 **$59.95** (2.98)
2.0" includes 1.25" adapter.
#13003 **$99.95** (3.95)

MONEY-BACK GUARANTEE
If you are not completely satisfied with your purchase from Orion, for any reason,
100% Satisfaction
Just return it in new condition within 30 days after delivery for a prompt refund.

IT'S EASY TO ORDER!

- Call toll-free and charge to your MasterCard, Visa or Discover Card or send your personal check to order by mail.
- California residents add 7.25% sales tax (8.25% in Santa Clara and Santa Cruz Counties, 8.5% in San Francisco).
- Shipping & handling charge for UPS Ground or US Mail to lower 48 United States are listed in parentheses after each price. We ship to U.S. and Canada only.
- We expected the prices in this ad to be accurate for September 1994 at the time of our advertising deadline in July. Please call our toll-free number for current pricing and to receive our latest catalog. Prices are subject to change or correction without notice.

MasterCard
DISCOVER
VISA

ORION
TELESCOPE CENTER
2450 17th Ave., P.O. Box 1158-A
Santa Cruz, CA 95061-1158
When ordering, mention key code KMA
Business Offices (408) 464-0446

Call Toll-Free
800-447-1001

Snatching Beauty from the Deep Sky

Razor-sharp portraits in black and white capture exquisite detail in deep-sky objects.

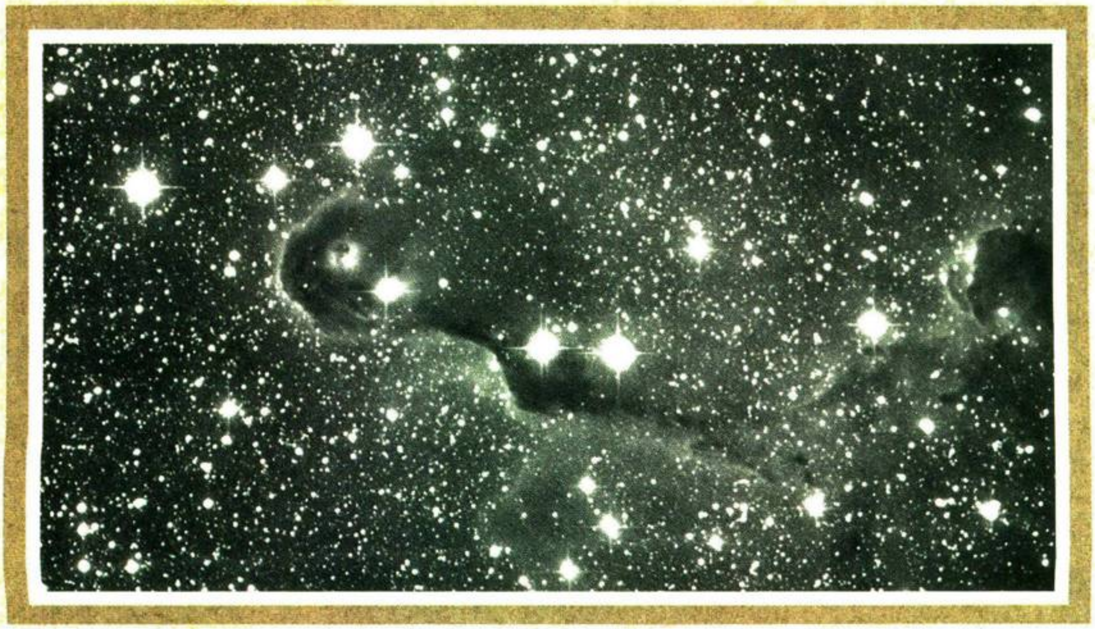
Story and photos by Martin C. Germano

Color photos of deep space objects dominate the look of ASTRONOMY. Indeed, they are pretty and capture a wide range of color not visible in the eyepiece. But for those who wish to record the most detail in galaxies and nebulae, nothing beats black-and-white film. The much higher resolution of films like Kodak's Tech Pan — the leader in deep-sky photographic film for more than a decade — makes possible storing fine details on film that mimic the details of photos made by great observatories years ago.

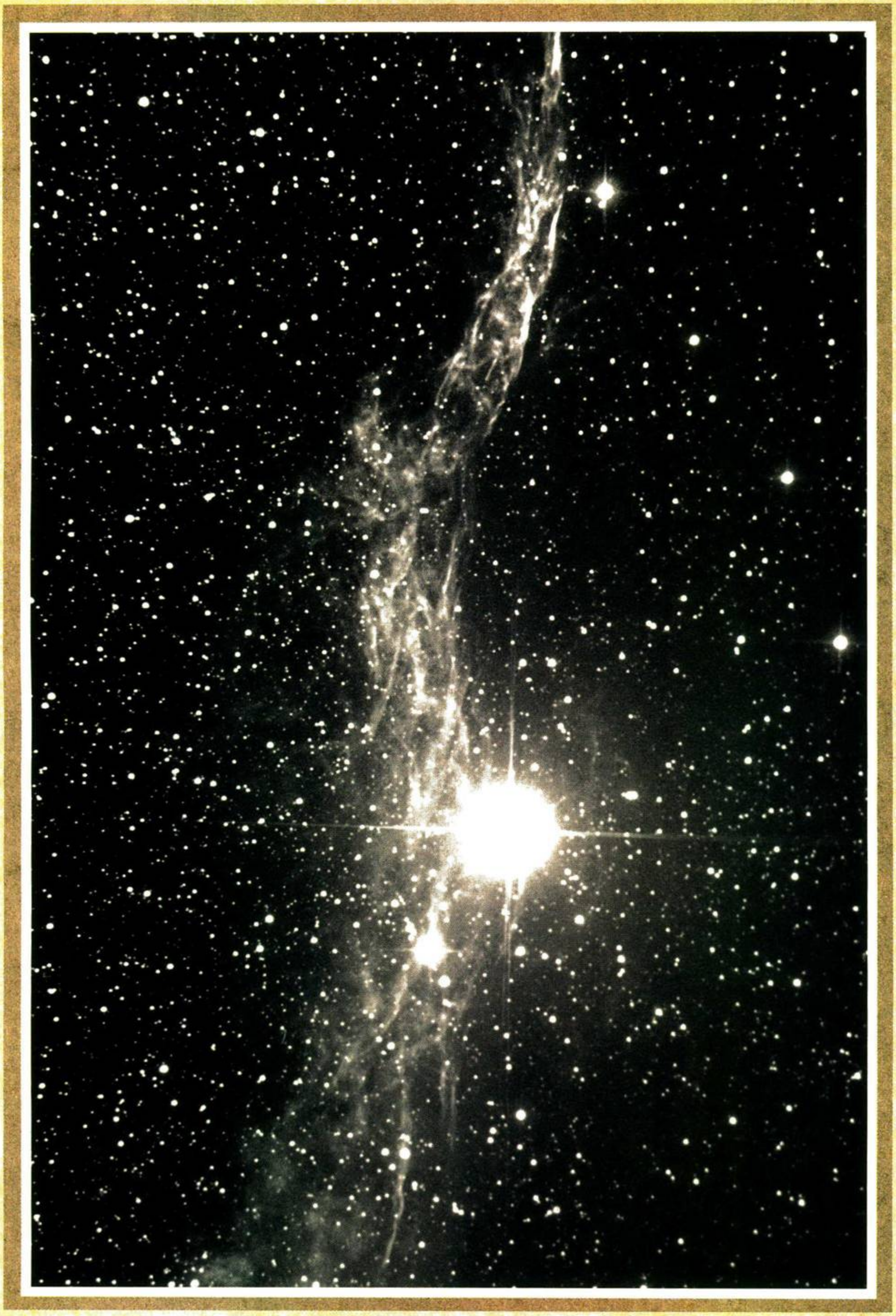
More recently, backyard astronomers have increased their enjoyment of deep-space photography in two important ways. First, by hypersensitizing Tech Pan film they have effectively speeded up the film's recording of faint light. Hypersensitizing film involves exposing it to a gas mixture that increases its sensitivity. This hypering process cuts down the exposure time needed to record faint details from several hours to anywhere from 10 minutes to 2 hours. (A number of astronomical retailers sell hypered film through the mail.)

Second, they have begun using automatic guiders. Anyone who has taken a long-exposure photo with a telescope knows that the worst part about it is the guiding. Sitting for an hour or two with an eye glued to an eyepiece making minute tracking corrections while watching a guide star can drive a person crazy from fatigue. Fortunately, automatic guiders end this suffering and make electronics do the dirty work.

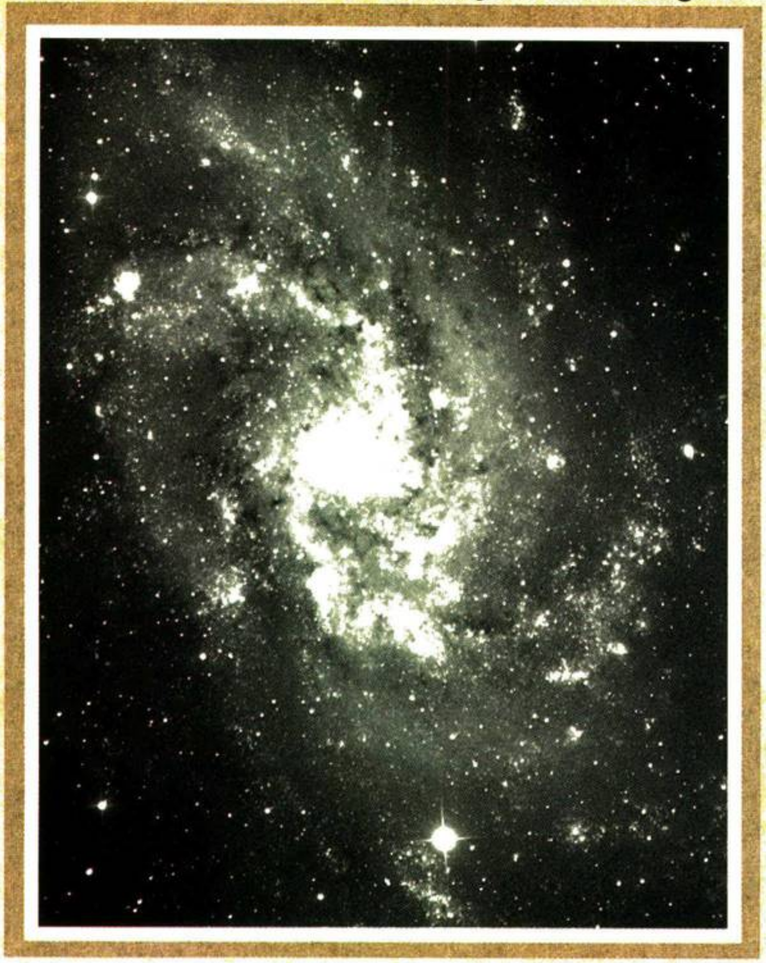
Dark nebula van den Bergh 142 in Cepheus



The Veil Nebula (NGC 6960) in Cygnus



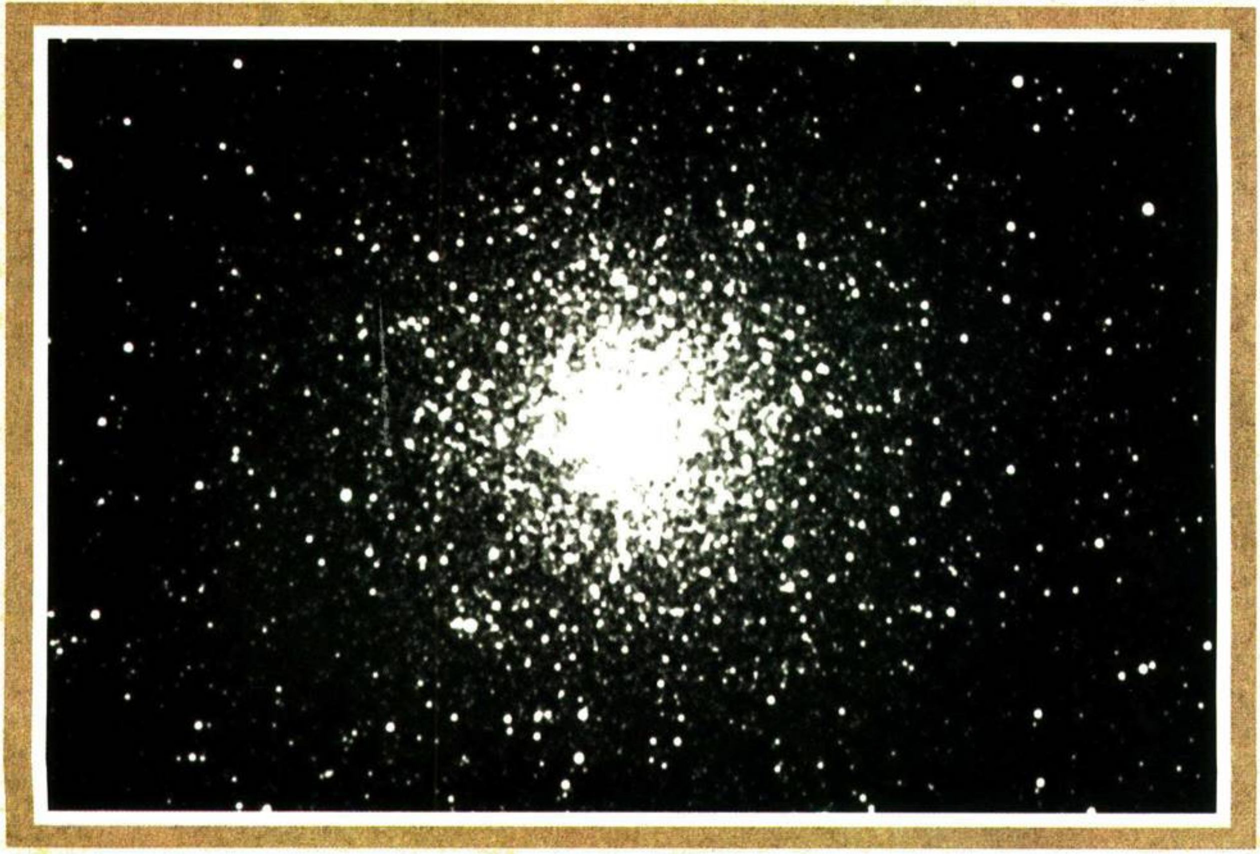
Galaxy M33 in Triangulum



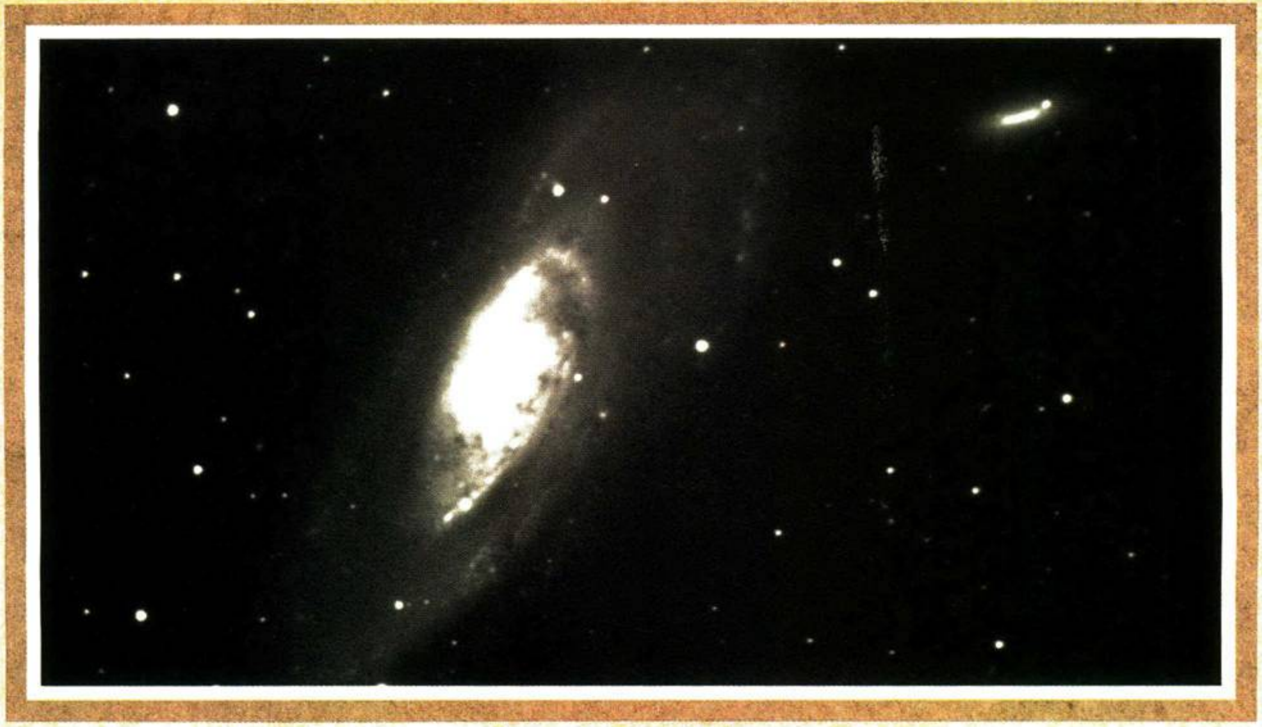
The net result is that it's much easier to make black-and-white exposures of galaxies and nebulae than it was a couple of years ago. Not run-of-the-mill exposures, either, but "deep" exposures that reveal outer shells around planetary nebulae, bridges of luminous material between galaxies, crisp edges of dark nebulae, and intricate spiral patterns in the inner and outer arms of galaxies. High-resolution deep-sky photography of the 1990s, therefore, creates a stark new beauty in old, familiar objects.

Creating the right combination of telescope, mounting, accessories, film, and exposure time is critical to success. Although almost any type of telescope works for deep-sky photography, it dictates something about the objects to be photographed. Telescopes with large fields of view work well for objects like Milky Way fields, big galaxies, and dark nebulae. This means using a relatively short focal length scope with a relatively "fast" (low) focal ratio. Exposure times typically range from 10 to 45 minutes. Longer focal-length telescopes work best for small objects like planetary nebulae, globular clusters, small emission nebulae, and average galaxies. Shooting such objects typically requires exposure times of one to two hours.

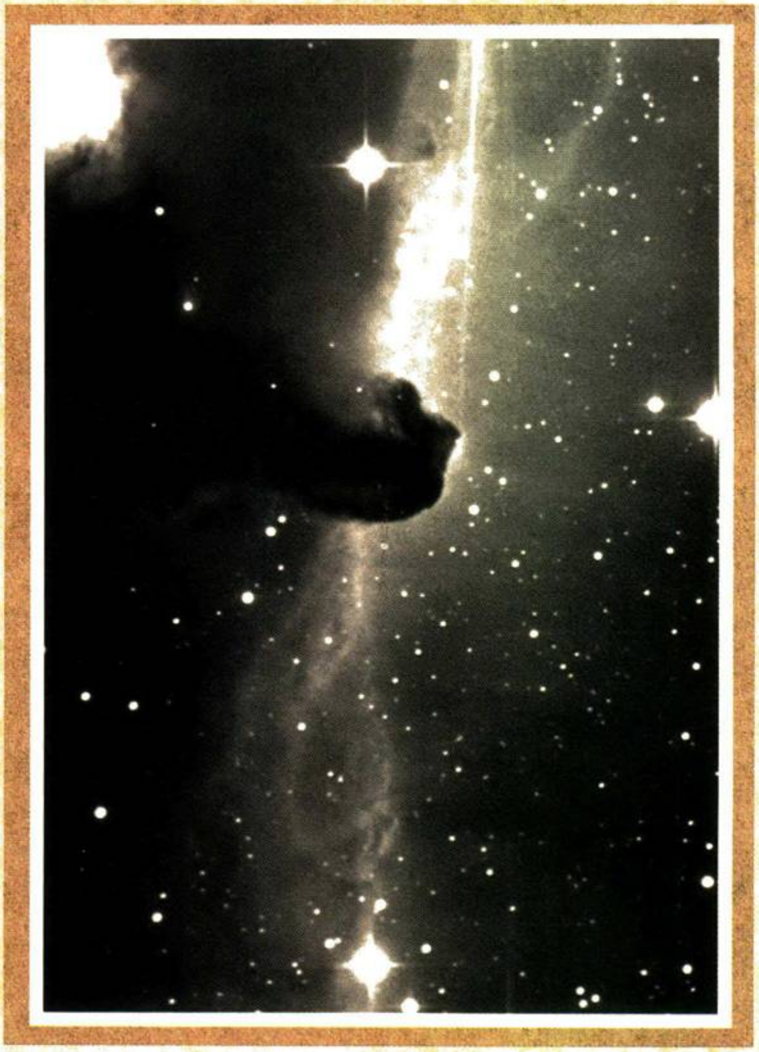
Globular cluster M55 in Sagittarius



Galaxy M106 in Canes Venatici



The Horsehead Nebula in Orion

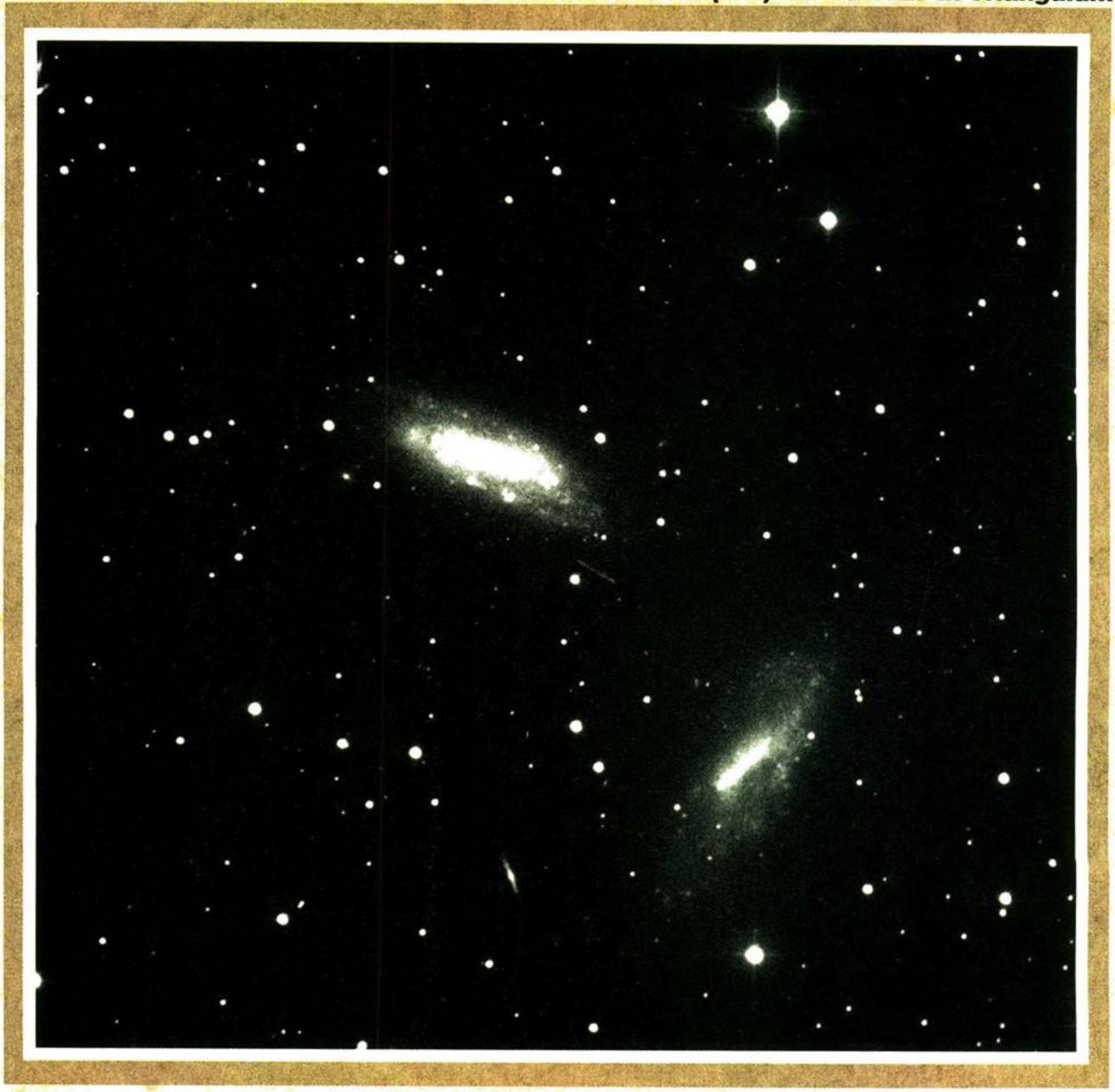


For years I approached the problem of capturing both types of objects by using an 8-inch f/10 SCT for small objects and an f/5 focal reducer to photograph large galaxies and nebulae. Now I'm happy with an 8-inch f/5 reflector (for wide-field photography) and a 14-inch f/5 reflector (for small objects). The camera is less important. You can use any 35mm SLR camera that allows critically sharp focusing and uses a mechanical shutter that can stay open for long periods.

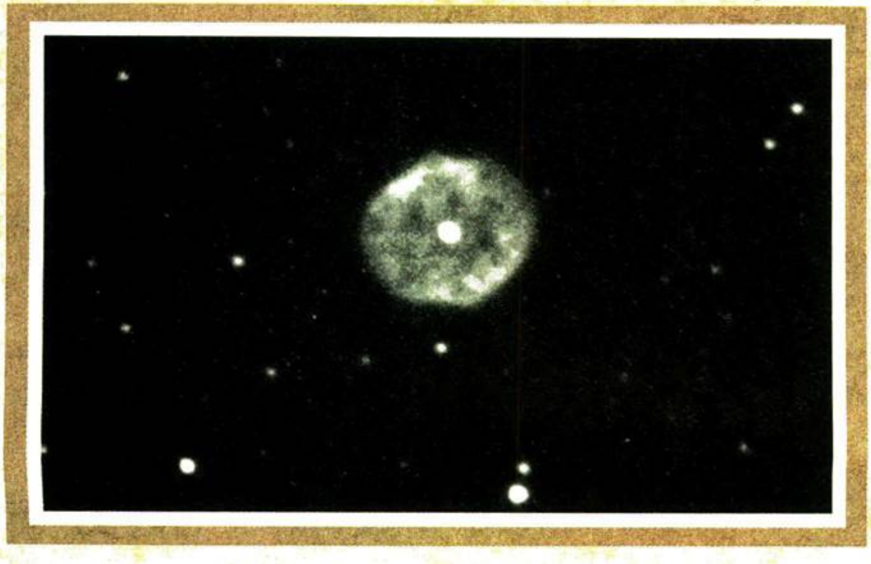
The choice of mounting is less flexible. A mount must provide rock-solid stability and smooth tracking. This is essential if you want to transport your photographic rig to various sites. I use a solid mounting made by the Edward Byers Co. of California and a tripod built from steel to maximize stability. Mountings really can't be overdone. Even with an exceptionally sturdy mount, wind can be a problem if it gusts over 15 miles per hour. Some nights just aren't made for astrophotography.

On good nights, however, you need to worry about polar alignment. Orienting the mount properly by aiming its polar axis toward the pole permits accurate tracking. Many mounts now come with built-in polar-alignment optics. Without such a polar-alignment device, it's necessary to follow the age-old method (see "Polar Aligning Your Telescope," May 1992). Precise alignment greatly helps both human-guided and computer-guided photos. Guiding works with either an off-axis guider, an optical device in the light path of the main telescope, or with a separate guidescope. An off-axis guider is a

Galaxies NGC 672 (left) and IC 1727 in Triangulum



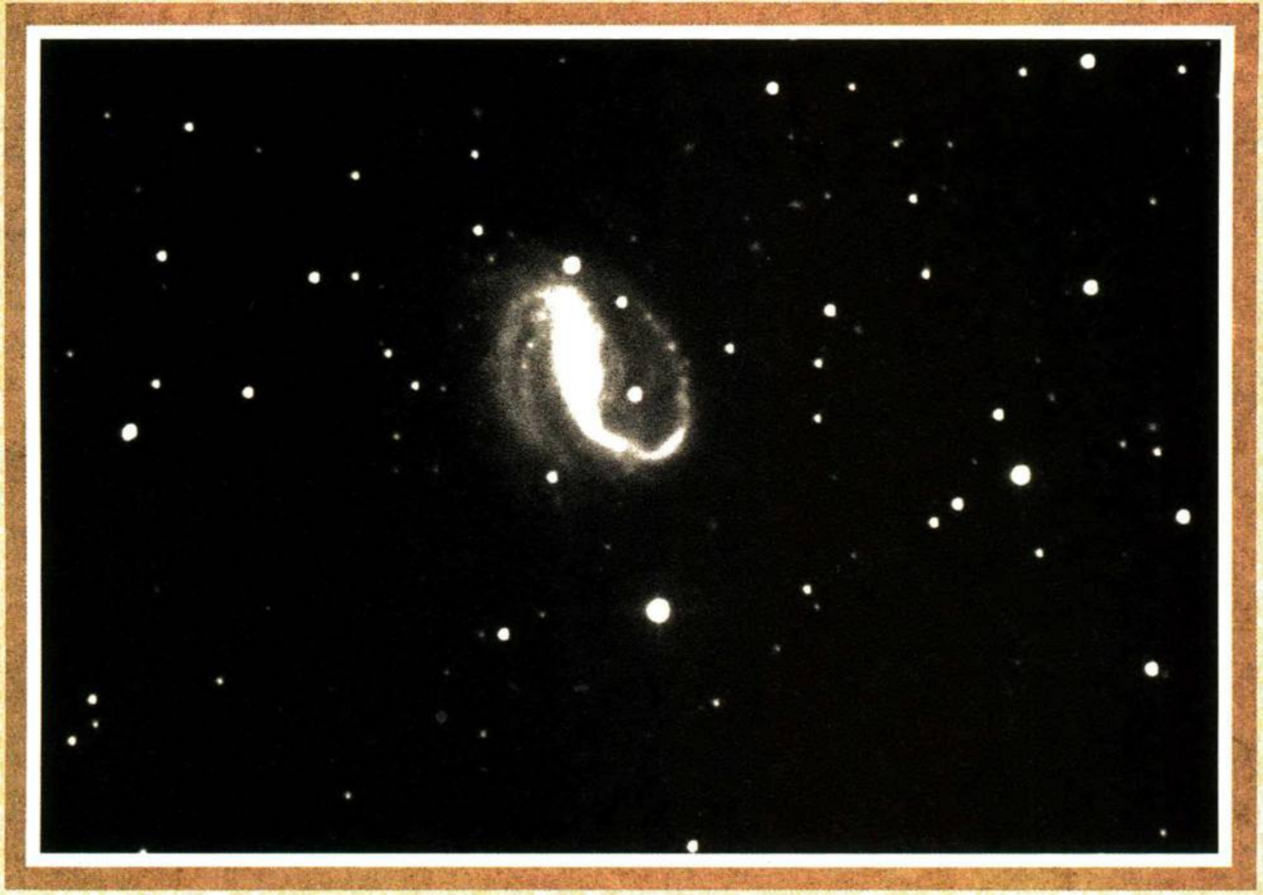
Planetary nebula NGC 1501 in Camelopardalis



safer bet because it reduces the possibility of flexure, minute changes in alignment between the guidescope and the main scope that sometimes occur during an exposure. This can cause trailed stars in astrophotos. One more accessory benefits users of conventional reflectors — a coma corrector. This is a lens that reduces the distortion of star images near the edge of the scope's field of view.

Once your photographic system is together and works smoothly, experiment. The real fun lies not in shooting the same old 50+ objects (the Orion Nebula, the Andromeda Galaxy, etc.), but the thousands of little-known nebulae and galaxies that lie scattered across the sky at any time on any clear night. To find out about the lesser-known objects, read all of the

Galaxy NGC 7479 in Pegasus

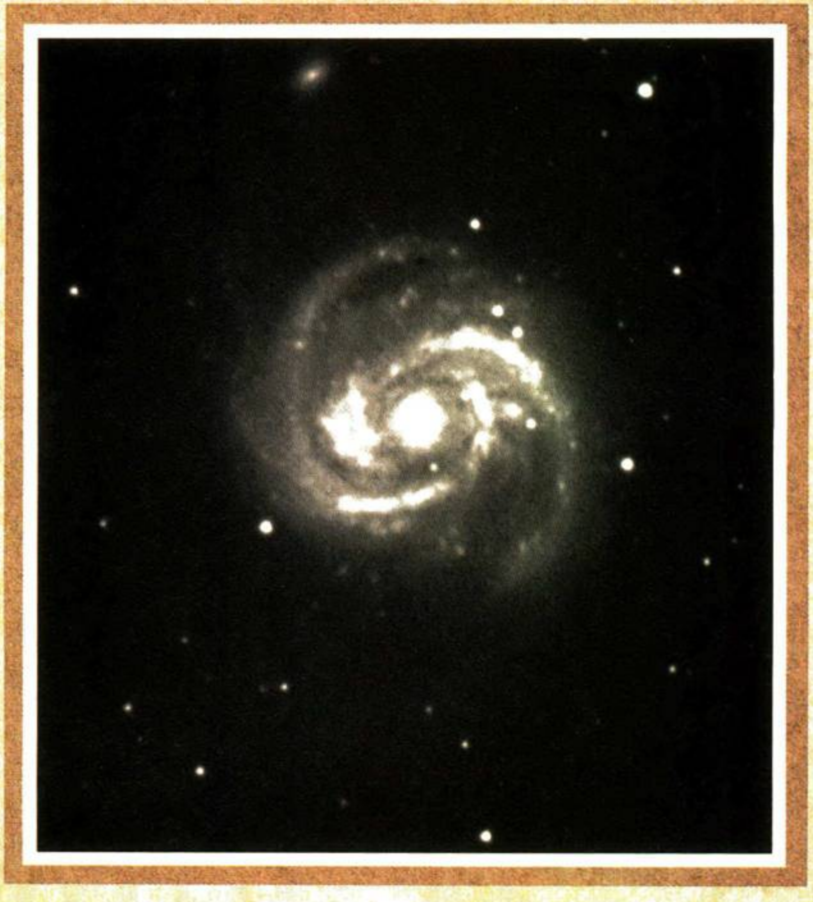


sources of information on deep-sky observing you can. Watch for photos of objects in ASTRONOMY and explore catalogs such as *Sky Catalogue 2000.0, The Deep Sky Field Guide, Burnham's Celestial Handbook*, and atlases such as *Uranometria 2000.0* and *Sky Atlas 2000.0* to compose lists of targets to photograph. Still more objects reside in the computer-based mapping software *Megastar* and the *Arizona Database*.

Most important of all, don't take the published descriptions of objects as gospel. Go after anything that appeals to you; often you'll be able to capture objects of surprisingly faint magnitudes. With a telescope and camera optimized for high-resolution photos, you may find yourself amassing a collection of captivating objects that go way beyond the Messier and NGC lists. Anyone for a Sharpless object? A P-K planetary? A UGC galaxy? The sky's the limit . . . ☐

Martin C. Germano's photographs have appeared in ASTRONOMY for more than 15 years. Germano regularly photographs the sky from several dark mountain sites north of Los Angeles.

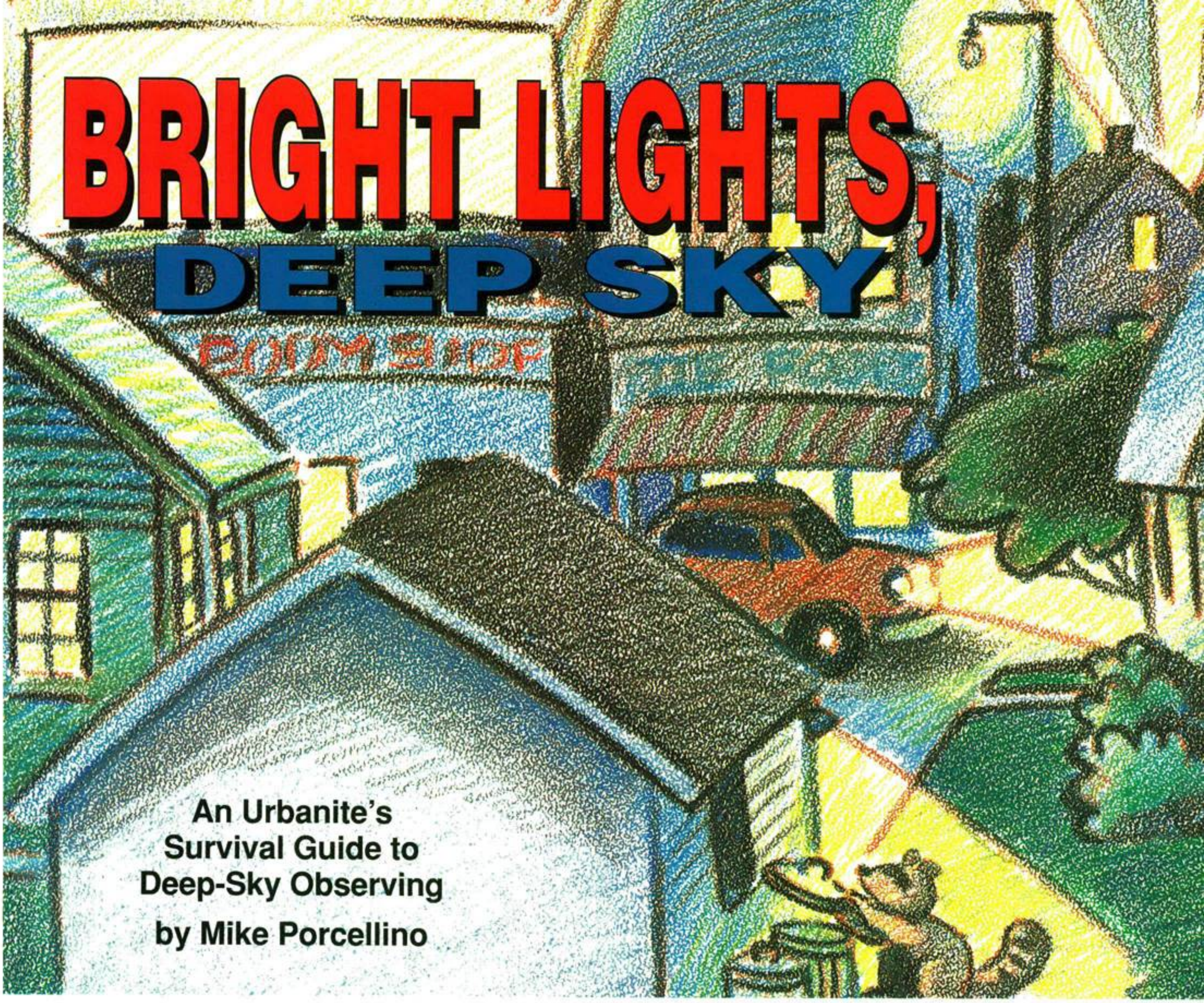
Galaxy M100 in Coma Berenices



BRIGHT LIGHTS, DEEP SKY

An Urbanite's Survival Guide to Deep-Sky Observing

by Mike Porcellino



“City dwellers should forget about observing deep sky objects and concentrate on the planets and the Moon.”

That's said so many times that people have begun to believe it. They have forgotten just what can be seen from an observing site smack in the middle of an urban area. Could it be that the naysayers have been whining too much? Well, the short answer is yes. With the right tools and techniques, deep-sky observing from the city is not only possible, but more productive than one might think.

Consider what might be a typical backyard observing site that lies within a large metropolitan center. In the west there's sky glow from a number of newly developed shopping centers. To the north is a high school athletic field (complete with a glaring lighting system), while to the east is the skyglow from a major part of the city itself. From the south rises the glare of growing suburbs. Ringing the site are seven high-pressure sodium street lights. This doesn't sound like a place for deep-sky work, does it?

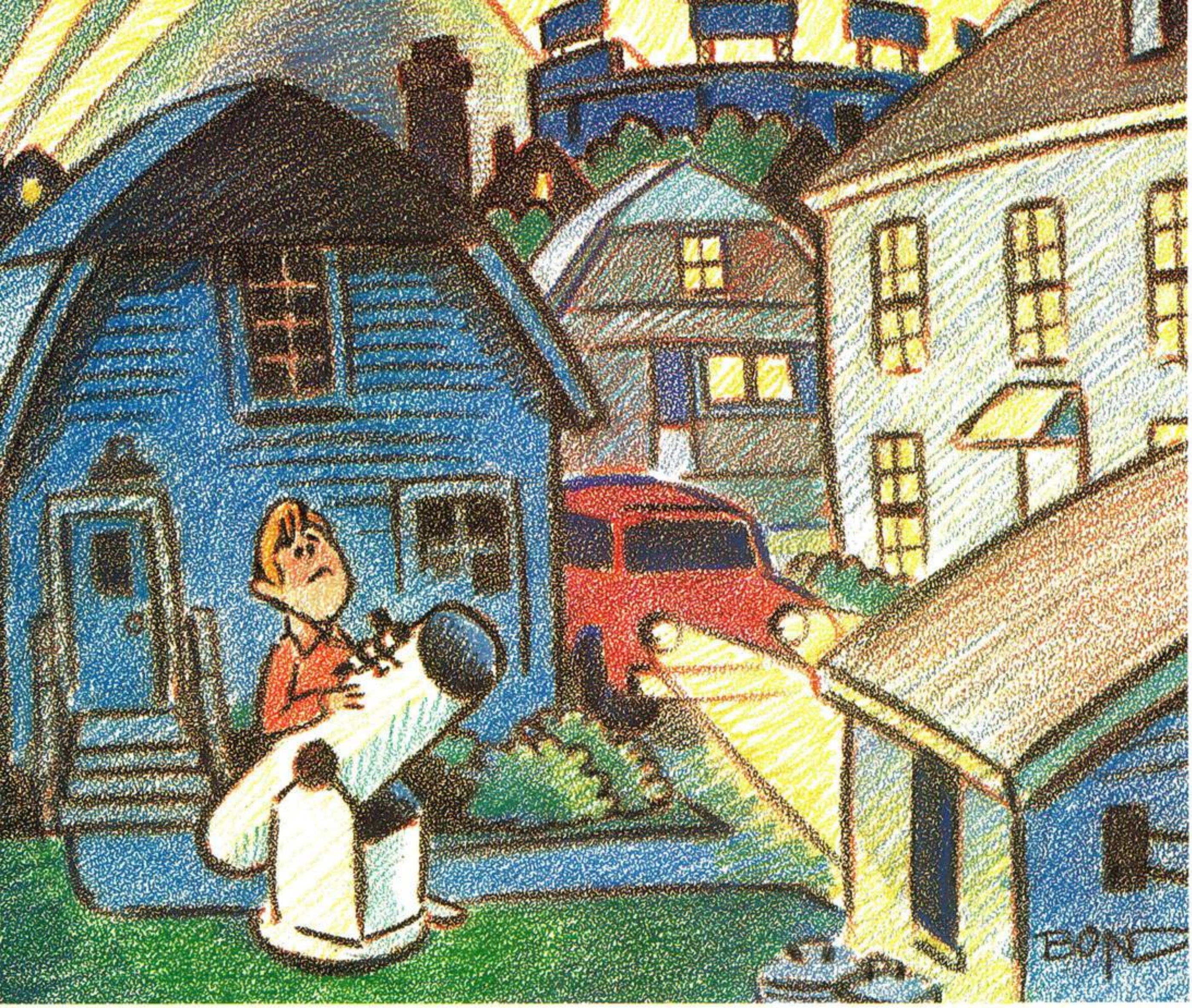
Despite these handicaps, this urban site is rather good. While the Milky Way is invisible, on a good night 5th-magnitude stars are detectable near the zenith. The unaided eye can see Andromeda's great spiral galaxy M31, Sagittarius' glowing gas cloud M8, and a number of other bright deep-sky objects with no trouble. On a very good night the globular cluster M13 might be glimpsed with the naked eye when it is near zenith.

The typical telescopes in an amateur's arsenal, a 4-inch f/10 refractor and a 13.1-inch f/4.5 reflector, can reach down to magnitudes 12.5 and 14.8 respectively. If they were used at this site, both factors that make for a viable observing session would seem to be present: workable skies and equipment that can see faint stuff. However, regardless of how promising the skies look and what telescopes are used, the most pivotal factor in seeing deep-sky objects, whether observing in the city or country, is an object's brightness.

How Bright Is That Object?

Sometimes a telescope's limiting magnitude doesn't help much when observers try to determine when deep-sky objects are visible. Deep-sky objects cover a measurable area of sky and hence are called *extended objects*, as opposed to point-source objects like stars. With a point-source object the intrinsic brightness is concentrated into a single pinpoint of light, so a star of magnitude 7 looks as bright as any other star of the same magnitude. When it comes to extended deep-sky objects, two targets with the same magnitude could look completely different.

Most lists of deep-sky objects give total magnitude, the magnitude an object would have if all of its light were gathered into a single point source. But the light of an extended object is spread out over a given area, so its real brightness de-



Bruce Bond

pends not only on total magnitude but also size. Something with a seemingly bright magnitude but a large surface area appears invisible to an observer.

This effect is dramatically illustrated by the large spiral galaxy M33. With a total visual magnitude of 5.7, M33 should be a spectacular sight to the unaided eye, binocular, or telescope. But remember that its brightness is spread over an area 62' by 39' (a larger area than the Moon's), so M33 actually appears as a magnitude 14 object!

Other extended objects such as open and globular clusters are more forgiving because a scope resolves them into individual stars. Observing an open cluster is usually a matter of picking it out of a background of other, non-related stars. With globular clusters, some of the brighter ones resolve into stars, while the fainter ones appear as diffuse glows.

Stop the Stray Light

When it comes to urban observing there's one thing all extended objects suffer from: light pollution. That pollution can take on two forms: sky glow and light that shines directly into the telescope or your eyes. Methods exist to combat this light pollution on several fronts.

An urban observer's number one goal is to increase the contrast between an extended object and its light-polluted background sky. Cleaning the telescope's optics can go a long way toward accomplishing this.

When the optics are dirty, every speck of dust on the primary or secondary in a Newtonian scatters the incoming light, and that scatter can overwhelm the faint glow of the object. Clean optics can allow the telescope to see objects one or even two magnitudes fainter.

Another way of cutting down on scattered light is to be sure as little extraneous light as possible reaches the optics. Place a tube extension or light shield on the front end of the scope. If you're using a reflector, shield the mirror-end of the telescope to prevent light from entering the tube through the back.

Other ways of controlling stray light include observing with a hood that covers your head and the focuser, slipping rubber eyecups on the eyepiece to snug your eye against, and employing a movable light shield near the focuser to block light from a certain direction. Observing in the shadow of something like a tree or a building can also eliminate quite a bit of light trespass.

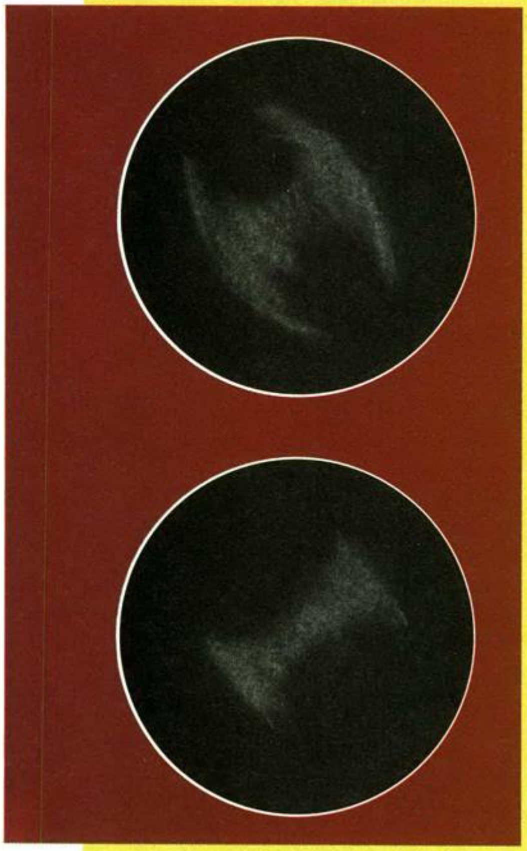
Fight Back with Filters

If the above tactics don't provide enough relief, it's time to move to the next (and arguably the most powerful) weapon in the urban astronomer's arsenal: light pollution filters.

About the only nice thing to be said about light pollution is that it's often restricted to specific wavelengths in the visible spectrum. Mercury-vapor streetlights emit most of their light in narrow bands found in the yellow, yellow-green, and blue

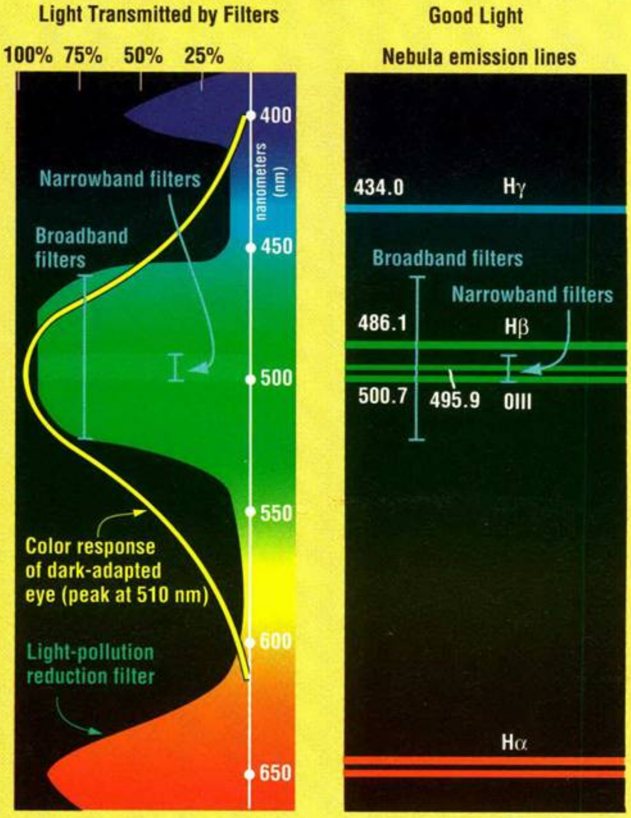
Filters: An Urban Observer's Best Friend

URBAN LIGHT POLLUTION comes from many sources. The spectrum of a typical urban sky, continuous from violet all the way to red, comes from incandescent light sources, like the porch light your neighbor leaves on all night. Super-



A LITTLE FILTERING goes a long way, as shown in these drawings of the Dumbbell Nebula, M27, in Vulpecula. The bottom drawing was made without the benefit of a broadband filter. The general dumbbell shape is there, but some of the outlying structure washes out due to light pollution. A filter blocks urban skyglow and more of the nebula's light appears, allowing the observer to perceive M27's cusps (top drawing). Another esthetic benefit that comes from using a filter: the sky looks darker.

Mike Porcellino



parts of the spectrum. Low-pressure sodium lamps primarily give off yellow light. The most difficult artificial light to filter is from high-pressure sodium lights, which emit a broader array of wavelengths, from orange through yellow-green light. In general, most light pollution occurs in the blue and yellow parts of the spectrum.

Filters reduce the amount of background light your target object is seen against. A broadband nebula filter blocks many of the wavelengths given off by artificial light to yield a darker field of view. But typically these filters pass light found only in the green part of the spectrum. This green area of the spectrum is also where a dark-adapted eye is most sensitive. While this may also slightly reduce the brightness of a target object, these filters work because the brightness of the object decreases much less than that of the background sky, which increases the contrast between the object and the sky. To a lesser extent, these filters might help objects that emit a broader spectrum of light, such as galaxies and star clusters.

Narrowband filters, such as Lumicon's UHC and Orion's Ultrablock, pass a still narrower range of green light through. These filters are optimized for emission nebulae such as M8 (the Lagoon Nebula) and M42 (the Orion Nebula).

Planetary nebulae inherently offer the city observer an edge. Because these objects emit light in small portion of the spectrum, a line filter such as an Oxygen III can help them stand out even more from the background sky glow. This filter transmits a very narrow range of green wavelengths (coincident with what planetaries emit) and eliminates even more of the background light pollution without sacrificing the light of the object.

For more information on filter types and their characteristics, refer to "ASTRONOMY Tests Ten Nebular Filters," (February, 1991).

The Eyes Have It

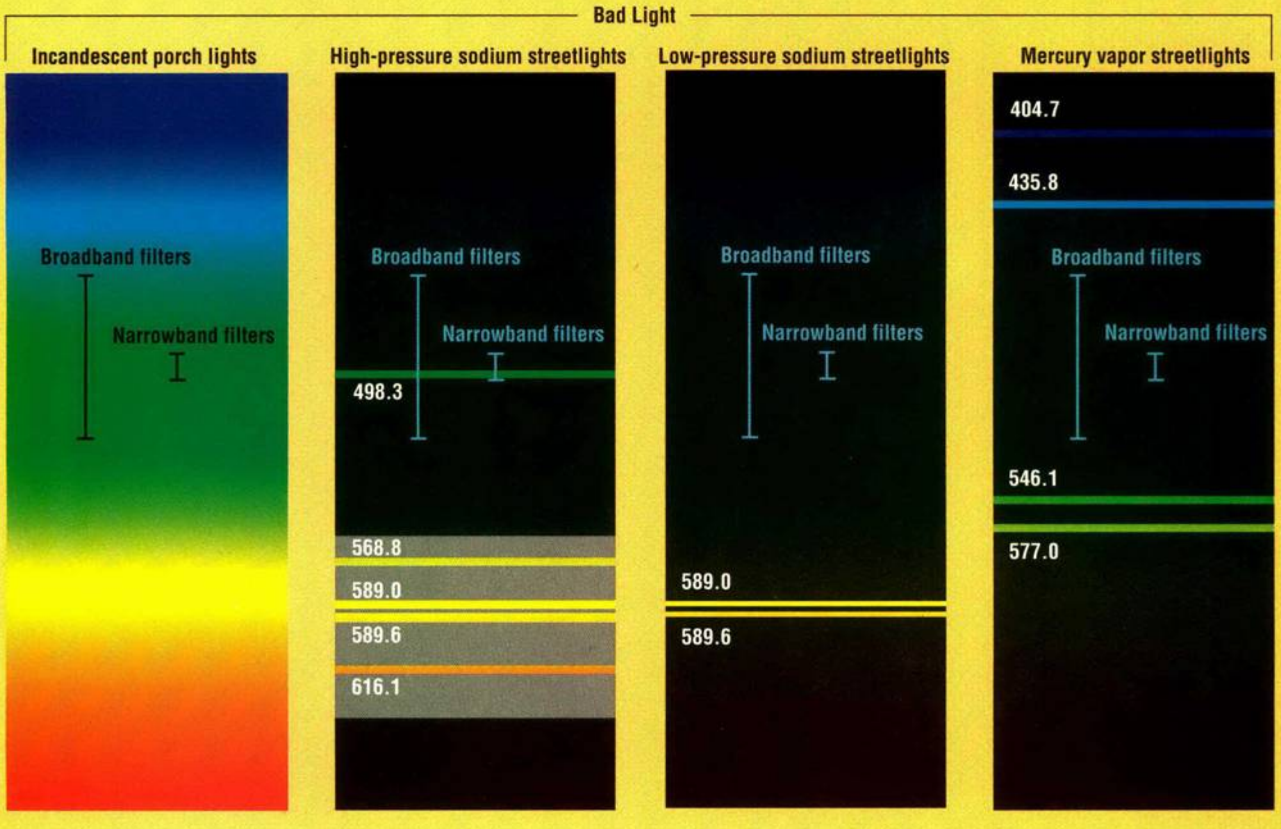
The last stop in our quest to wring deep-sky objects out of urban skies lies in the human eye itself. Insights into some simple physiology can go a long way in understanding what is seen in the eyepiece.

Detail! Aren't the cones of the eyes needed to see detail, and don't they need a lot of light to be activated? If this is true, how can an observer see detail in a faint object? Because the retina's low-light receptors, the rods, respond to faint levels of light. While they cannot detect fine detail, they do pick up subtle variations in contrast, which is why an observer can discern a certain amount of detail in many deep-sky objects.

For instance, take M31. When detecting dust lanes in the galaxy's spiral arms, the eye is actually spotting differences in contrast between the darker lanes and the brighter main body of the galaxy. The brain pieces the picture together to record a neural image of a dark foreground gradually brightening toward the main body of the object.

For an object like M33, a face-on spiral, the eye sees a difference in contrast between the spiral arms and imposed on this incandescent spectrum are bright lines and bands that come from mercury-vapor and from low- and high-pressure sodium lamps. Mercury-vapor lights emit narrow line in the yellow, yellow-green and blue portions of the spectrum. Low-pressure sodium lamps emit only a narrow pair of lines in the yellow end. High-pressure sodium lamps, the most common form of streetlight, emit a broader band of wavelengths from yellow to yellow-green.

Emission lines from nebulae are found mainly in the green part of the spectrum, which coincides with the peak sensitivity of the dark-adapted human eye. Filters transmit this select portion of the green spectrum while blocking unwanted blue and yellow light.



ASTRONOMY: Phil Kirchmeier

the background sky in the field of view. The spiral arms are faint, but they are brighter than the sky. The brain interprets this to yield a neural image of spiral feature. Anything that enhances these subtle variations reveals more detail.

And this is where our efforts lead. The aim of the urban observer is to increase the contrast between an object and its sky background. The more the contrast, the easier the job for the rods of the eye as they feed a signal to the brain. In one outburst of "Aha!" the brain sees the object and — voilà — suddenly it's deep sky in the city!

Seeing Is Believing

But theory is theory — what about practice?

In a field test using a 4-inch, f/10 refractor from a shielded corner of an urban observing site, M27 displayed the expected "hourglass" shape of the Dumbbell, but there was no real detail in the nebula. After throwing a hood over my head and sliding a glare shield over the front of the telescope to block stray light, I applied a broadband filter. The filter had increased the contrast between the nebula and the background sky, allowing my eye to detect the subtle variations between sky and object. Detail from the corners of the "hourglass" built up on my retina, and as a result, I saw the Dumbbell's extensions. Under similar conditions I observed M27 with a 10-inch f/4 reflector out in an open, unshielded area of the site, without a filter or observing hood. The extensions were invisible, proving that contrast is everything.

Backyard astronomers have made fascinating reports of dark lanes' being visible in the Hercules Cluster (M13), so I attempted to find them with a 13.1, f/4.5 reflector. After bumping up the magnification on the instrument, the globular steadily showed more and more detail until at 125x the dust lanes appeared, forming the "Y" shape reported by other observers.

These examples show that an observer working under urban skies can see a large amount of detail in deep-sky objects if he or she tries. While it would be nice to escape to dark sites, far from the intrusion of city skyglow, many of us cannot. And regardless of whether you're a city or country observer, another secret to getting the most out of observing lies in how often you observe. The brain learns from experience, so the more one observes the more one sees. To be an accomplished observer requires having a trained eye. That means observing on a regular basis, whenever it's possible.

Being trapped under city skies should not be a hindrance to observing but a challenge. Amateur astronomers are a crafty lot, and they can usually find a way to overcome any obstacle when it comes to their observing program. They only have to try. ☐

Before passing away two years ago, Michael Porcellino was an avid lunar, planetary, and deep-sky observer living in Chicago. He was a regular contributor to ASTRONOMY.

Under The Southern Sky

Tour the skies down under with an Australian astrophotographer.

A NEARBY GALAXY REIGNS in the southern sky. The Large Magellanic Cloud appears to the unaided eye as a patch above the author's observatory (top) and shows many star clusters and nebulae through binoculars (above). Southern observers also enjoy seeing the center of our Milky Way Galaxy in Sagittarius passing overhead in winter (opposite).

Photos and Story by Jim Barclay

We Southern Hemisphere observers have many advantages over our Northern Hemisphere counterparts. We see two of our Milky Way Galaxy's 11 satellite galaxies with our unaided eyes: the Large and Small Magellanic Clouds. And we see Orion high in our summer sky, the center of the Galaxy as it passes nearly overhead, and a globular star cluster that appears to the unaided eye nearly as large as the Full Moon. These celestial sights make astronomy in the Southern Hemisphere a rewarding hobby.

And of course, views well known to northern observers take on a new look below the equator. For example, the Hyades in Taurus look like an arrow poised to fly upward. The bright star Sirius in Canis Major, which skims above the horizon at northern latitudes, passes overhead around midnight on January 1. Orion stands on his head with his sword levitating straight up from his belt. And the Full Moon has Mare Crisium on the left and Tycho, the bright rayed crater, at top. Many northerners find it difficult at first to navigate around the familiar but topsy-turvy sky. Throw in 20 or 30 totally unfamiliar constellations and they'll need a guide to find their way

OMEGA CENTAURI SHINES BRIGHTLY from the combined light of a million stars. Located 17,000 light-years from Earth, the globular cluster is one of the most distant objects in our Galaxy observers can see with the unaided eye. The cluster is visible to backyard astronomers below 35° north latitude.

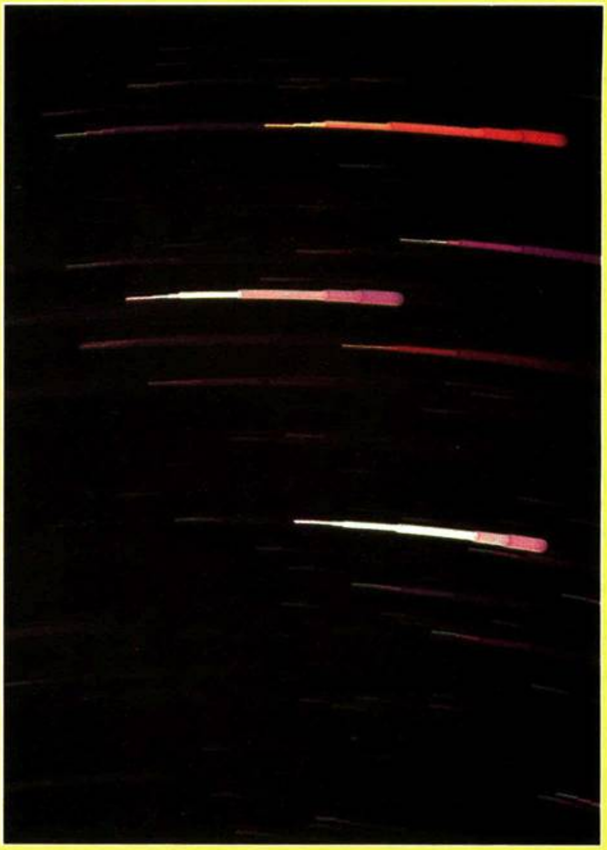
around. Let me take you on a tour to introduce you to some of the best objects in the southern sky.

October marks springtime in the Southern Hemisphere and the rising of one of the greatest sights in the night sky — the Large Magellanic Cloud, usually called the LMC by astronomers. To the naked eye, it appears as a soft glow in the constellation Dorado and shows up as a bright smudge even in star trail photos. This cloud of tens of billions of stars is a companion galaxy of the Milky Way Galaxy as is the Small Magellanic Cloud in Tucana, which also is visible to the naked eye. Astronomers thought the LMC was the closest galaxy to ours, but the recently discovered Sagittarius dwarf galaxy now has that honor — or liability because our Galaxy is tearing that dwarf galaxy apart. The gravity of our Galaxy has also distorted the LMC, changing it from a barred spiral galaxy into the irregularly shaped object we see.

The closeness of the LMC, only 170,000 light-years away, means that an observer with binoculars can see within the confines of the galaxy dozens of objects such as emission nebulae and star clusters. The brightest is the Tarantula Nebula (NGC 2070), an emission nebula 800 light-years across that is visible to the naked eye. A small telescope shows the loops of gas that look like the legs of a giant spider and give the Tarantula its name. The nebula contains a star cluster called 30 Doradus. While amateurs with 16-inch telescopes can detect the star cluster as a faint smudge, the repaired Hubble Space Telescope shows several thousand newly formed stars in the heart of the cluster. If this nebula were as close as the Orion Nebula, it would cover 30° — the width of 60 Full Moons side by side — and shine brighter than Venus.

Visible around midnight at a little more than 30°, or about three handwidths, from the Tarantula is another fantastic emission nebula, the Keyhole Nebula (NGC 3372) in Carina. The Keyhole, which surrounds the massive star Eta Carinae, is so bright that it appears to the unaided eye. A 4.5-inch telescope shows the dark lanes that divide this nebula, one of which looks like a keyhole and provides the nebula with its nickname. A

STAR COLORS BECOME VIVID when the focal length of a zoom lens is slowly increased during a star trail exposure. Red giant Gacrux (Gamma Crucis) is at top and orangish giant Epsilon Crucis is at center.

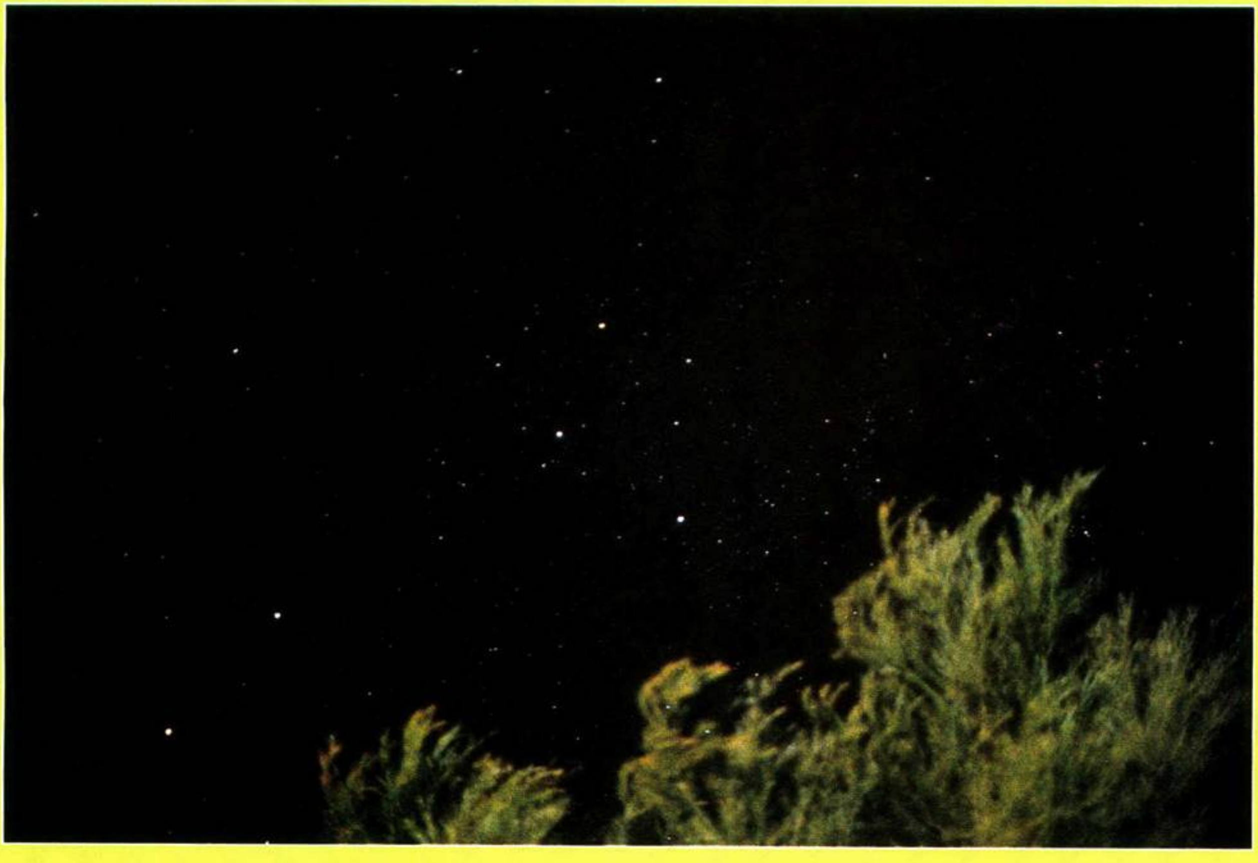


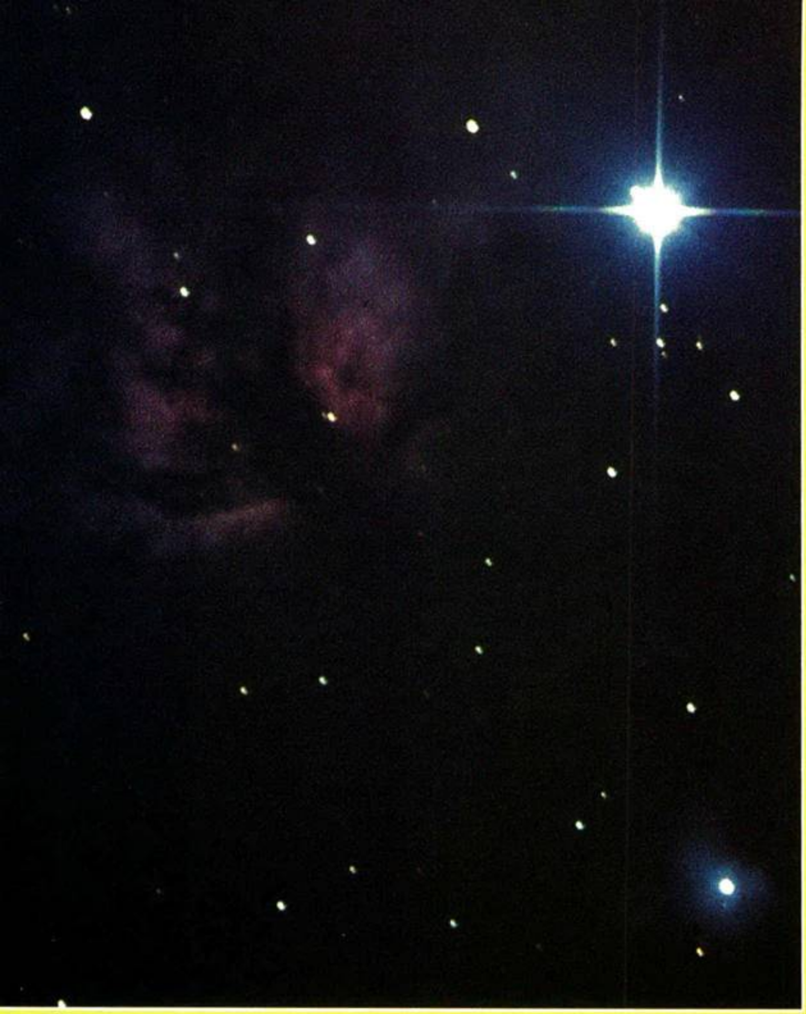
12-inch scope reveals around Eta itself the Homunculus Nebula, a gas cloud that looks like a little man or stick figure. Eta occasionally puffs off a layer of its outer atmosphere as it ages, contributing to this gas cloud.

In the southern sky after sunset is Crux the Southern Cross. A line drawn from Gacrux (Gamma Crucis, the northern tip of the cross) to Acrux (Alpha Crucis, the southern tip of the cross) and extended across the sky will pass roughly through the south celestial pole. But besides being a pointer to the pole, Crux contains some other interesting objects, because the Milky Way passes through the constellation. Just east of Acrux an inky black hole interrupts the gauzy band of the Milky Way. This dark nebula is the Coal Sack, which lies only 500 light-years away. Within the Coal Sack is an open cluster of about 30 stars, NGC 4609, which requires a 10-inch scope to see well. Nearby is a prettier, richer cluster called the Jewel Box (NGC 4755), which centers around orangish Kappa Crucis. Small scope owners can easily see the gemlike red, yellow, and bluish white star colors that give the cluster its name.

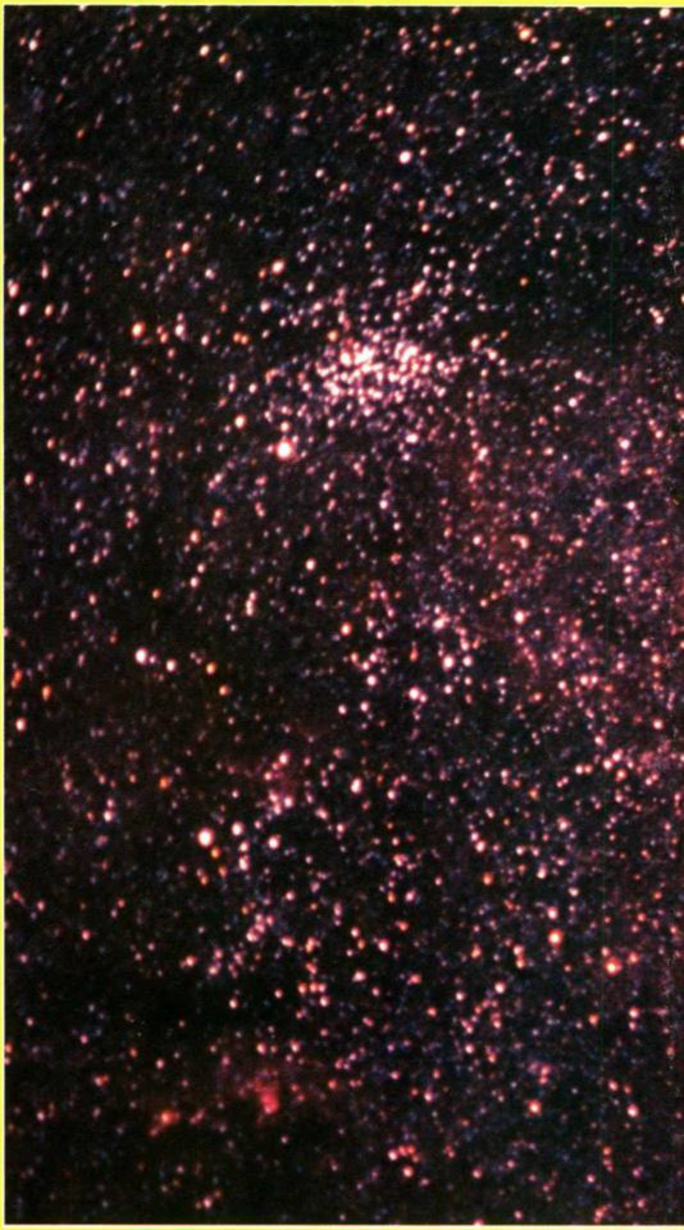
Near Crux in the southwestern sky is Centaurus the Centaur, the site of the nearest star to the Sun and a gi-

THE SOUTHERN CROSS POINTS to the south celestial pole (off the bottom of the page, behind the tree). Crux forms the center of this nightscape with Carina to the right and Centaurus above and to the left. Alpha Centauri, one of the stars closest to Earth and the third brightest star in the night sky, lies at bottom left.





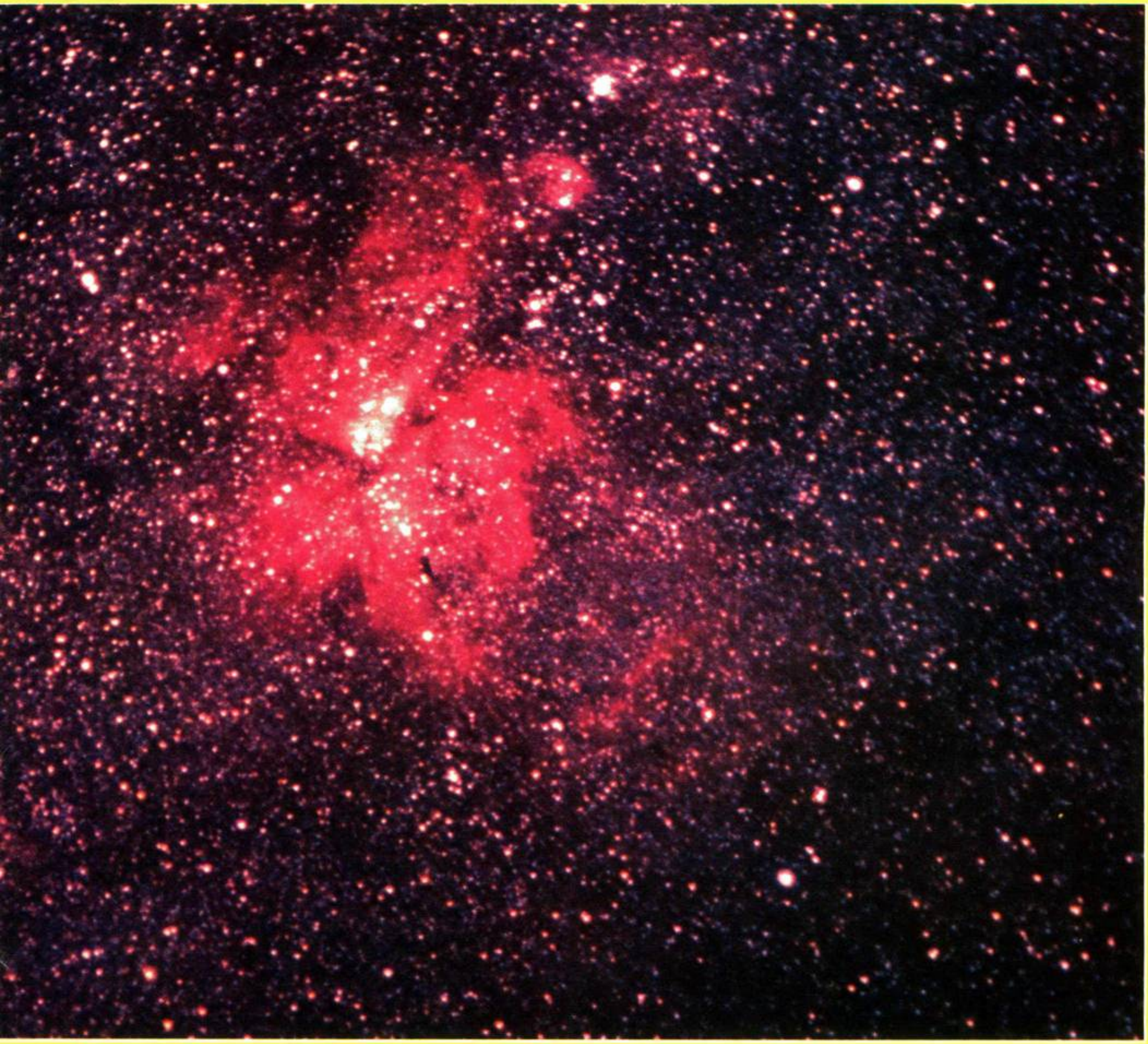
A BRIGHT EMISSION NEBULA LURKS near Zeta Orionis (above). The nebula (NGC 2024) lies just north of the more famous Horsehead Nebula that sits to the east of Orion's belt.



THE INKY BLACK COAL SACK BLOCKS light from stars in the Milky Way near Crux. The dark nebula lies only 500 light-years away. Above the Coal Sack is a beautifully colored star cluster called the Jewel Box.

ant cluster of stars visible to the naked eye. Rigil Kentaurus ("the foot of the Centaur," also called Alpha Centauri) is the brightest star in the constellation, the third brightest star in the night sky, and the second closest star to the Sun. Coincidentally, the star is a nearly identical twin to our Sun. The star nearest to the Sun is 11th-magnitude Proxima Centauri. Reddish Proxima lies 3° southwest of Alpha, and astronomers, until recently, had long considered it to be a companion to Alpha. They are now trying to decide whether Alpha's gravity is strong enough to hold Proxima in its wide orbit around Alpha or whether the reddish star just happens to be passing through the neighborhood.

Traveling 17° northwest of Alpha in the twilit sky, we come to a giant globular star cluster, Omega Centauri (NGC 5139), which covers over half a degree of the sky and is larger than the diameter of the Full Moon. Even



THE KEYHOLE NEBULA IS HOME to Eta Carinae, one of the most massive stars known. Eta is slowly blowing off its outer layers and forming its own nebula called the Homunculus at the center of the Keyhole.

though this cluster contains over a million stars, it appears as a small fuzzy patch to the naked eye. The cluster received a star's name because early observers couldn't distinguish it from a star. It lies 17,000 light-years away from Earth and is one of the most remote objects in our Milky Way Galaxy you can see with the unaided eye. With binoculars the tiny disk will begin to break apart. A 4-inch telescope reveals hundreds of individual stars in the outer regions, while a larger scope will show an unbelievable number of stars, which give the cluster an almost three-dimensional appearance.

Concluding our tour is Orion the Hunter, a region of sky familiar to northern observers. Orion rises about 10 p.m. in October and appears about 60° above the horizon when it transits the local meridian, or north-south line. A half-degree south of Zeta Orionis, the easternmost star in Orion's belt, is the famous Horsehead nebula. In their haste to catch a look at the elusive Horsehead, many backyard astronomers overlook a larger and easier-to-see emission nebula, NGC 2024. It lies about 20 arcminutes east of Zeta. Like many star-forming regions, NGC 2024 shines by the light it reradiates from the hot young stars inside. The glare of bright Zeta tends to make observing the nebula difficult but a 6-inch telescope will show the two halves of the gas cloud.

Although Orion standing on his head is an oddity for northern observers, it's not sufficient cause to hop on a plane and fly to the Southern Hemisphere. But the overflowing basket of treats of the southern sky — its galaxies, nebulae, and star clusters — are more than ample reason. Perhaps the pictures in this article will convince you to wind your way down under and stand beneath the southern sky. □

Jim Barclay's astrophotos appear regularly in ASTRONOMY. *He lives near Brisbane, Queensland, Australia.*

Meade & Celestron
LUMICON Carries a full line of telescopes & accessories. Fast Delivery, competitive prices

LUMICON FOR HIGH PERFORMANCE

ASTROPHOTO OF THE MONTH

NGC 55 in Sculptor. 2 hour photo by Andrew Peters (from South Australia) using hypered 2415 film and a 20" f/5 telescope with LUMICON Coma Corrector and LUMICON 2" Easy-Guider. "The Coma Corrector is a terrific accessory," stated Mr. Peters. You may need to use a LUMICON Deep-Sky Filter to see NGC 55 visually.

"I'd Pick The TELE VUE™"

40mm Wide-Field Test, "Astronomy," Aug. 1990, p. 90

Genesis 4" f/5 4 element fluorite	$1885
Pronto 70mm f/6.4 apochromat w/2" diagonal	$825
Pronto 70mm f/6.4 w/45° erecting prism	$725
Renaissance-SDF 4" f/5.4, brass	$2095
Gibralter mount with ash wood tripod	$495
7.4, 10.4, 13, 17, 21, 26mm Plossl 50°	$79
1.8x or 2.5x Tele Vue Barlow Lens	$89
2" Giant Barlow - 2x	$169
32mm Plossl, widest true field in 1¼"	$109
55mm 2" Plossl, widest possible field	$219
15mm Wide-Field, 1¼" eyepiece, 65°	$135
19mm Wide-Field, 1¼" eyepiece, 65°	$145
32mm Wide-Field, 2" eyepiece, 65°	$239
40mm Wide-Field, "Rich-Field!" 65°	$299
4.8mm Nagler, 82° field, 1¼" eyepiece	$149
7mm Nagler, 1¼" eyepiece, 82° field	$189
9mm Nagler, 82° field, 1¼" or 2"	$219
13mm Nagler, 82° field, 1¼" or 2"	$249
12mm Nagler, Type II, 82°, 1¼"/2"	$249
16mm Nagler, Type II, 82°, 1¼"/2"	$289
20mm Nagler, Type II, 82°, 2" only	$340
1¼" Paracorr Visual Coma Corrector	$159
2" Paracorr Visual Coma Corrector	$249
NEW! 15mm Panoptic 1¼", 68° field	$199
NEW! 22mm Panoptic 1¼"/2", 68°	$249
NEW! 27mm Panoptic 2", 68° field	$299
NEW! 35mm Panoptic 2", 68° field	$325

ADJUSTABLE PIGGYBACK MOUNT

The LUMICON adjustable piggyback mount is ideal for telescopes of 6-16" aperture. It permits **both** vertical and sideways adjustment for optical alignment. Also ideal to mount LUMICON 80mm SUPER-FINDER™, large telephoto lenses and small telescopes up to about 5 lbs.

LUMICON Adjust. Piggyback Mount $59.50
Specify telescope size: 6", 8", 10", 11", 14", 16"

H-ALPHA PASS FILTER

Yields spectacular contrast gains in B&W photograph with telephoto lenses. Yields pinpoint star images. Superb with hypered 2415. For color, use the Minus Violet (MV) Filter.

Specify Lens Size	H-Alpha	(MV)
46, 48, 49mm	$59.00	$49.00
52, 55, 58, 62mm	$69.00	$59.00
67, 72, 77mm	$79.00	$69.00
82mm	$89.00	N/A

Hypered 2415 film, 36 exp .. **$11.95, $3/$32**

NEW! ENHANCED ALUMINUM DIAGONAL MIRRORS BOOST TELESCOPE PERFORMANCE

LUMICON 1.3" & 2.1" enhanced aluminum diagonal mirrors & 1¼" star diagonal.

The new LUMICON diagonal mirrors have a special enhanced aluminum coating with a protective overcoating for long life. Visible reflectivity is 94-96% compared to 86-89% for standard aluminum coated mirrors. The extra 5-10% transmission is like adding up to an inch of aperture! The substrate is fine annealed Pyrex flat to 1/8 wave.

1.32"	**$39.50**	1.52"	**$45.00**	1.83"	**$49.50**
2.14"	**$59.50**	2.60"	**$75.00**	3.10"	**$99.50**

ENHANCED ALUMINUM STAR DIAGONAL

90° star diagonals with 96% reflectivity enhanced aluminum mirrors in a CNC machined black anodized aluminum body. Performance far exceeds prism diagonals.

1¼" (1.32" mirror)	**$99.50**
2" (1.83" mirror)(see photo above)	**$165.00**

LUMICON FILTERS — BEST IN THE WORLD!

"The LUMICON OIII proved to be our favorite... It gave the greatest contrast gain."
ASTRONOMY February 1991

AMAZING OIII FILTER™

Helix Nebula, NGC 7293 in Aquarius. Bright and easy with Lumicon Oxygen-III Filter.

The ultimate in filter performance! The Lumicon Oxygen-III Filter has a contrast twice as high as the high performance Lumicon UHC Filter™. Use the Oxygen-III Filter for observing the very faintest planetary and diffuse emission nebulae. Also gives incredible views of bright nebulae (like M-27, M-17, etc.) from urban locations. Bandpass is 11nm, transmission is 90-96% for both O-III lines at 496nm and 501nm.

SEE THE HORSEHEAD!

Horsehead Nebula in Orion. This faint nebula is seen best with a LUMICON H-Beta Filter. Photo by J. Marling using a Deep-Sky Filter.

"I CAN SEE THE VEIL NEBULA!"

Rich Zepernick saw the Veil Nebula for the very first time with a **LUMICON UHC Filter**. He stated, *"It was actually there! and not just around 52 Cygni, but the whole loop! Words cannot possibly express my feelings. I don't know how I managed without these filters."*
Rich Zepernick, Cresskill, NJ

DEEP-SKY FILTER™

BEST for Astrophotography!

"Stunning is all I can say," says noted astrophotographer Jack Newton. Great for BOTH color and black and white photography.

BEST WIDE-BAND FILTER!

"Based on our tests we'd recommend a LUMICON Deep-Sky and Oxygen-III as complementary filters. The LUMICON Deep-Sky Filter clearly had the best contrast for ***reflection*** *nebulae."*
Astronomy, Feb. 1991

	Premium*
0.96" LUMICON DEEP-SKY Filter threads into most 0.96" eyepieces	$59.50
1¼" LUMICON DEEP-SKY Filter threads into most 1¼" eyepieces	$79.50
48mm LUMICON DEEP-SKY Filter (1.7" aperture), threads into most 2" eyepieces. Also fits LUMICON EASY-GUIDERS	$119.50
2" LUMICON DEEP-SKY Filter (1.5" aperture), threads into most 2" eyepieces. Also has male & female camera T-threads for prime focus photography	$119.50
72mm LUMICON Giant DEEP-SKY Filter (62, 67, 77mm adapter, $8)	$299.50
2" Rear Cell Filter, fits SCT's Deep-Sky, **$119.50** UHC, O-III, H-Beta,	$199.50
1¼" LUMICON UHC Filter threads into most 1¼" eyepieces	$99.50
48mm LUMICON UHC Filter (1.75" aperture) fits most 2" eyepieces	$199.50
Set of both premium **DEEP-SKY** and **UHC Filters** (Save 11%) ... 1¼" **$159.50**; 48mm	$279.50
LUMICON H-BETA Line Filter (9mm bandpass at 486nm). For the California Nebula, Horsehead Nebula, and other extremely faint nebulae. **1¼"** **$99.50, 48mm**	$199.50
Oxygen-III Filter for very faint planetary and diffuse nebulae, 11nm bandpass at 496nm and 501nm O-III lines **1¼" $99.50, 48mm**	$199.50
Telephoto lens adapter for 2" or 48mm filter. Select 46, 49, 52, 55, 58mm	$6.95
Universal adapter for 1¼" filters. Adapts the 1¼" filters to any 1¼" eyepiece	$16.00
Universal adapter for 48mm or 2" filters. Allows use of any 1¼" eyepiece	$20.00

**Premium filters are currently the best in the world. All Lumicon filters include individually measured transmission data.*

DEEP-SKY ASTROPHOTOGRAPHY

SR-V 3200 NEW FILM

FILM HYPERSENSITIZATION KITS†

LUMICON HYPER-KITS™ yield 3-15x film speed gain in long exposures. They are safe & simple to use. Easy HYPER-KIT includes a chamber with all controls and fittings, thermometer, a refillable cylinder of non-flammable forming gas & hand-operated vacuum pump.

U.S. Patent 4,473,636

MAKE YOUR OWN HYPERED FILM

MODEL 300 HYPER-KIT sensitizes any 35mm film in hours. Best for 2415. Achieves highest possible film speeds **$325**

MODEL 600 HYPER-KIT (See photo) Like the Model 300, but also sensitizes 120/220 larger format film and small glass plates **$395**

MODEL 1200 HYPER-KIT is for 4X5" plates and film up to 5X7". Has 2 gas cylinders and includes temperature controller ... **$595**

Temperature controller for any HYPER-KIT **$65**

Electric Vacuum Pump, Model R-10 **$325**

GUIDE OFF-AXIS FOR LOVELY ASTROPHOTOS

All **LUMICON EASY-GUIDER™** off-axis guiders† have both radial and 360° rotational adjustments for 5X easier guide-star selection, use 48mm filters, 360° camera rotation, large prisms for bright guide-stars.
Specify Camera and Telescope type.
U.S. Patent 4,448,500

NEWTONIAN EASY-GUIDER™

Full aperture. Installs in seconds. Specify 2" or 1¼".

NEWTONIAN EASY-GUIDER **$189.50**
3X Relay Diagonal (see photo) **$89.50**
Illuminated reticle eyepiece, pulsed . **$109.50**
Guider for Hasselblad **$409,** Mamiya 645 **$199**
Pentax 6X7 **add $119;** Pentax 645 **add $139**

CASSEGRAIN EASY-GUIDER™

For C-8, Meade 2080, Cynamax-8. Includes 50mm achromatic lens for f/5.8 operation—3X shorter exposures! **Superb rich field viewing, too!**

CASSEGRAIN EASY-GUIDER **$249.00**
Adapter for Hasselblad **$225,** Mamiya 645 **$98**
Pentax 6X7 **add $119;** Pentax 645 **add $139**

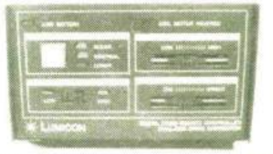
GIANT EASY-GUIDER™

For Celestron-11, C-14, and the 10" Meade 2120. Includes 80mm clear aperture achromatic lens for edge-to-edge illumination & pin-point star images. F-ratio adjustable f/4-f/11. **Also yields unmatched Rich-Field viewing.**

GIANT EASY-GUIDER **$395.00**
48mm DEEP-SKY Filter ordered with any EASY-GUIDER (SAVE $20) ..... **add $99.95**
Adapter for Hasselblad **$295,** Mamiya 645**$149**
Pentax 6X7 **add $129;** Pentax 645 **add $149**

WHAT DO YOU NEED?

1. Illuminated reticle eyepiece **$99.50**
Lumicon 12mm eyepiece system has adjustable LED illumination, dual crosslines, battery pack.
2. Cable release for long exposures .. **$9.95**



3. **LUMICON Digital Drive Corrector** . **$249**
Dual-axis drive corrector is essential for astrophotography and/or field use of your telescope. 30Hz/90Hz variable output controls telescope drive. 60Hz digital reference ±12VDC Declination control output. Both 110VAC and 12VDC input for home or field use. Dec. reverse switch for Newtonians.

Declination motor (state telescope) ... **$109**
Variable dec. speed drive w/built-in 5AH battery **$299**

HYPERSENSITIZED FILM

NEW
SRV3200

YES! WE STILL HAVE FUJI HG400!

LUMICON Hypersensitized film is essential for good deep-sky astrophotography. Deduct 10% for 3 or more rolls (mixed o.k.). ***No C.O.D.s.***

Film Type, 35mm	Exposures	Price
2415, Ultra-fine B&W, red sens.	36	$11.95
SR-G3200, fastest of all, color neg	24	$13.95
Kodak Ektar 1000 fast, fine grain	24	$12.95
Fuji HG400 fine grain color neg.	24	$14.95
Scotchrome 400, fast slide film	12	$12.95
Fujichrome RD100, fine grain slide	24	$12.95
D-19 B&W Developer	1 gal.	$6.95

LUMICON®
2111 Research Dr. #5A, Livermore, CA 94550
For phone orders please call (510) 447-9570
FAX (6 PM-9 AM PST) (510) 447-9589
LUMICON Products catalogue FREE
All foreign orders add 8% ($10 minimum)
California residents add 8.25% tax.
Prices subject to change w/o notice.
Hrs: M-F 9 am - 5 pm, Sat. 11 am - 3 pm

NEW MEADE® 16'' LX200 $14,950 AT LUMICON

"What an astounding combination of high performance and low price!" Jack Marling, Ph.D., owner of LUMICON

TOLL-FREE ORDER LINE 1-800-767-9576 EXPERT INFORMATION 1-510-447-9570 FAX 1-510-447-9589

MEADE APOCHROMAT ED REFRACTORS

7'' f/9
Apochromat
Only
$5495
7'' IN
STOCK!

Meade 6'' f/9 Model 152ED Refractor shown with #1697 Computer.

See the Meade ad in this magazine for full specifications and product descriptions. ED = Extremely low dispersion glass which yields color-free virtually perfect images. PPEC = Permanent Periodic Error Correction "Smart Drive."

Model 102 ED 4'' f/9 Apochromat & mount (add $105 P&S)	**$2495**
Model 127 ED 5'' f/9 Apochromat & mount (add $125 P&S)	**$2995**
Model 152 ED 6'' f/9 Apochromat & mount (add $185 P&S)	**$4495**
Model 178 ED 7'' f/9 Apochromat & mount (add $215 P&S)	**$5495**

Medium format adapters ..... Mamiya 645, **$98;** Pentax 6X7, **$98**
Med. format EASY-GUIDER™: Mamiya 645, **$298;** Pentax 6X7, **$298**
Medium format EASY-GUIDER for Hasselblad **$495**

DRIVE SYSTEMS

#1697 Computer Drive, 747 object computer memory, automatic slewing to desired object **$695**
8,000 Object CNGC Library .. **$99** Polar alignment finder .. **$99**

OPTICAL TUBE ASSEMBLIES (OTA)

Model 102 ED/OTA 4'' f/9 OTA only (add $55 P&S)	**$1045**
Model 127 ED/APO-OTA 5'' f/9 OTA only (add $60 P&S)	**$1595**
Model 152 ED/APO-OTA 6'' f/9 OTA only (add $100 P&S)	**$2295**
Model 178 ED/APO-OTA 7'' f/9 OTA only (add $120 P&S)	**$3250**

Cradle ring assem. 4'' (4½'' OD tube) **$135;** 5'' (5½'' OD tube) **$145**
Cradle ring assem. 6'' (7'' OD tube) **$169;** 7'' (8'' OD tube) **$219**

EQUATORIAL MOUNTS

LXD 650 mount and standard field tripod (add $60 P&S)	**$1495**
LXD 750 mount and giant field tripod (add $100 P&S)	**$2475**

NOTE: Add the indicated packing and shipping (P&S) costs to each telescope for insured UPS shipment to your door.

MEADE DOBSONIANS

Drop shipped from Meade, add shipping charge in parenthesis.

6'' f/8 Starfinder Dobsonian ($39)	**$295**
8'' f/6 Starfinder Dobsonian ($49)	**$395**
10'' f/4.5 Starfinder Dobsonian ($69)	**$565**
12.5'' f/4.8 Starfinder Dobsonian ($79)	**$765**
16'' f/4.5 Starfinder Dobsonian ($45)	**$1295***

**Shipped truck freight collect; add $45 packing charge. Includes #682 focuser.*

NEW MEADE EYEPIECES

Series 3000 Plossl 1¼'' eyepieces: select 5mm, 6.7mm, 9.5mm, 16mm, 25mm ($3.45) .. **$57.95**
Select Any 3 . **$48.95 ea.;** Any 5 . **$46.95 ea.**
Series 3000 40mm Plossl 1¼'' eyepiece **$79.95**
Shipping charges of 4-5% are extra.

NEW MEADE 16'' LX200 SCHMIDT-CASSEGRAIN

16'' LX200 $14,950
8'' LX200
$2295

NEW Meade 8'' LX200 Telescopes

See the Meade ad in this magazine for full specifications & details. **LX100 Drive**, 2X, 32X speed control with PPEC (Permanent Periodic Error Correction "Smart Drive") & dual-axis hand controller. **LX200 Drive**, Full electronic control with PPEC, 747 object computer memory and automatic computer controlled slewing to desired object. *NOTE:* A wedge is **not** needed for visual observing with the LX200 Drive. Select f/10 or f/6.3 (no extra charge) for your Schmidt-Cassegrain.

8'' LX100 Schmidt-Cassegrain with wedge (add $105 P&S)	**$1995**
8'' LX200 Schmidt-Cassegrain with computer (add $105 P&S)	**$2295**
Wedge for photographing with 8'' LX200	**$139**
10'' LX100 Schmidt-Cassegrain w/super wedge (add $145 P&S)	**$2895**
10'' LX200 Schmidt-Cassegrain with computer (add $145 P&S)	**$2895**
NEW! 12'' LX200 (f/10 only) with computer (add $215 P&S)	**$3995**
Super Wedge for photography with 10'' or 12'' LX200	**$395**
NEW! 16'' LX200 f/10 w/super giant tripot (add $385 P&S)	**$14,950**

Dew Shields: 8'' - **$119;** 10'' - **$129;** 12'' - **$189;** 16'' - **$289**
Library Options (ver. 3.2 only) 10,600 objects **$99;** 64,350 objects **$149**

OTHER SCHMIDT-CASSEGRAINS

Meade 2045D 4'' f/10 with motor drive (add $40 P&S)	**$699**
Meade 2080B 8'' f/10 with tripod, wedge, MCOG (add $85 P&S)	**$1149**
Model 2120B 10'' f/10 w/wedge, tripod, MCOG (add $125 P&S)	**$1449**

PHOTOGRAPHY ACCESSORIES

LUMICON Cassegrain EASY-GUIDER 4'', 8'' only, f/6 or f/10	**$249**
LUMICON Giant EASY-GUIDER for 10'' or 12'' f/4-f/10 operation	**$395**

MEADE STARFINDERS

New 8'' f/6 Meade Starfinder telescopes

See the Meade ad in this magazine for full descriptions and technical specifications for 6'' to 16'' Starfinders. These are complete telescope systems with motor drive, mount, finderscope and 25mm (=48X) eyepiece.

6'' f/8 Starfinder 6(add $65 P&S)	**$599**
8'' f/6 Starfinder 8 (add $75 P&S)	**$699**
10'' f/4.5 Starfinder 10 (add $90 P&S)	**$799**
16'' f/4.5 Starfinder 16 (ship. freight COD)	**$2495**

*All Starfinder telescopes shipped directly from Meade to the purchaser. Please add the indicated shipping charge to the price. LUMICON showroom prices are $99 higher.

ACCESSORIES

LUMICON carries the full line of Meade accessories. See the Meade ad in this magazine for detailed prices and descriptions.

LUMICON Single axis drive corrector	**$99**
LUMICON DX200 Dual-axis drive cor.	**$249**
Meade 47M Dual-axis drive corrector	**$475**
LUMICON DX2BP Dual-axis drive corrector with built-in battery pack	**$299**

LUMICON® SKY VECTOR™

Higher Performance — Lower Price

LUMICON ACCESSORIES

LUMICON, 2111 Research Dr., #5, Livemore, CA 94550 (510) 447-9570 FAX (510) 447-9589

LOW PRICE—from $399

LUMICON SKY VECTOR FEATURES:

- "GUIDE" mode leads you to object
- Digital right ascension readout to 1 min.
- Digital decl. readout to 10 arc-min.
- 4000 pulse (0.09° accuracy) encoders
- Polar alignment ***not required!***
- Motor drive ***not required!***
- Just sight two stars to align!
- Works **equally well** for alt-azimuth telescopes like Coulter Odyssey and equatorial mounts like C-8, Meade 2080.
- **No need** to enter latitude, longitude, etc.

SKY VECTOR I™ $399

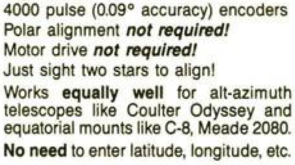
NEW! With over 220 object memory including the 110 Messier and 58 best NGC objects.

SKY VECTOR II™ $499

IMPROVED — Planets, Over 3,700 Objects! With size, magnitude and full visual description.

NGC SKY VECTOR™ $699

IMPROVED!—5500 Additions / Corrections



Improved NGC SKY VECTOR with over 12,000 object memory including the planets, complete, corrected RNGC catalogue, IC catalogue, P&K planetary catalogue, & much more!

Specify Telescope Type: Meade 2045, 2080, 2120, C-8, C-11, Odyssey 8, 10, 13, 17½, Alt-Azimuth.

Ultima 8, 11 .. **add $25**, C-14 .. **add $75**

COMA CORRECTOR

Coma 1 inch off-axis 17½'' f/4.5

Same field with LUMICON coma corrector; smaller, more numerous stars.

This computer-designed LUMICON 2'' lens reduces coma and flattens the field for both viewing and photography. **It threads into LUMICON 2'' EASY-GUIDERS for effortless installation.** This zero power lens does not change image scale nor shift focus, and all lens surfaces are multi-coated for highest efficiency. Clear aperture = 1.8''.

LUMICON 48mm Coma Corrector/Field Flattener Lens	**$285.00**
LUMICON 2'' EASY-GUIDER	**$169.50**
2'' EASY-GUIDER (Mamiya 645)	**$199.50**
2'' Adapter for Pentax 6X7	**$129.00**
2'' Adapter for Hasselblad	**$229.00**
2'' Adapter for Bronica SQ-A	**$175.00**
2'' Extension for viewing	**$26.00**

2'' DELUXE BARLOW

1.8x Multiplier Lens (2'' Barlow)

LUMICON 1.8x Multiplier Lens (2'' Barlow) **$235.00**

LARGE UV/DUST SEAL

Protect the optics of your 8-14'' Schmidt-Cassegrain with a UV/Dust Seal. Simply thread it onto the rear cell, then attach all normal accessories. The large size fits Meade 2120, Celestron-11 and -14 & has a high quality multi coated (removable) 72mm UV filter.

Deep-Sky Filter/Dust Seal for C-8, 2080	**$119.50**
UV/Dust Deal for Celestron C-8	**$39.00**
UV/Dust Seal for Meade 2080, 2045	**$39.00**
UV/Dust Seal (large) for Meade 2120	**$89.50**
UV/Dust Seal for Celestron-11, -14	**$89.50**

LOW PROFILE FOCUSERS

New! Thread-on for Odyssey

FROM $59.50

LUMICON® LOW PROFILE FOCUSERS

LUMICON now offers 3 different low-profile helical focusers. They stand oniy 1¼-1½'' above the telescope tube. Use the 1¼'' or 2'' versions for viewing. Use the 2'' non-rotating focuser for convenient photography with the LUMICON 2'' EASY-GUIDER™.

Select your desired base-plate shape! Coulter Odyssey (thread-on installation), Flat, 7'' OD, 9½'' OD, 12½'' OD, 16'' OD, 21'' OD.

LUMICON 1¼'' Helical Focuser	**$59.50**
LUMICON 2'' Helical Focuser 1½'' high	**$65.00**
LUMICON Non-rotating Helical Focuser	**$129.00**
2'' Astro Systems focuser, only 2'' high	**$139.00**
3 handles for non-rotating focuser	**$12.95**
2''/1¼'' adapter w/48mm filter threads	**$20.00**
2'' LUMICON EASY-GUIDER	**$169.50**

LUMICON 50mm, 80mm SUPER-FINDER™

Visual Astronomers prefer the LUMICON 80mm SUPER-FINDER™, since hundreds of deep-sky objects, including most Messier objects, are visible directly. SUPER-FINDERS also make nice small portable telescopes. 80mm aperture, F=300mm coated achromat or 50mm, F=200mm coated achromat. Eyepieces and/or star diagonal are extra.

1¼'' 50mm Finderscope **$59.50**, right-angle **$59.50**

1¼'' straight-thru 80mm SUPER-FINDER	**$179.50**
1¼'' right-angle 80mm SUPER-FINDER	**$189.50**
1¼'' right-angle version, w/star diagonal	**$229.50**
25mm Cross-hair 1¼'' eyepiece (12X)	**$49**
Large mounting rings for 80mm Finder	**$55**

1¼'' Star Diagonal **$49**, Mounting Brackets, **$39.50**
1¼'' 45° diagonal for correct left-right views **$52.44**

LOTS OF ADAPTERS

2'' adapter for C-8, Meade 2080, etc.	**$26.00**
2'' adapter for C-80, C-100 refractor	**$39.50**
2'' adapter for C-70, C-80F, C-100F fluorite	**$39.50**
2'' adapter for C-6, Comet Catcher, Meade 312	**$30.00**

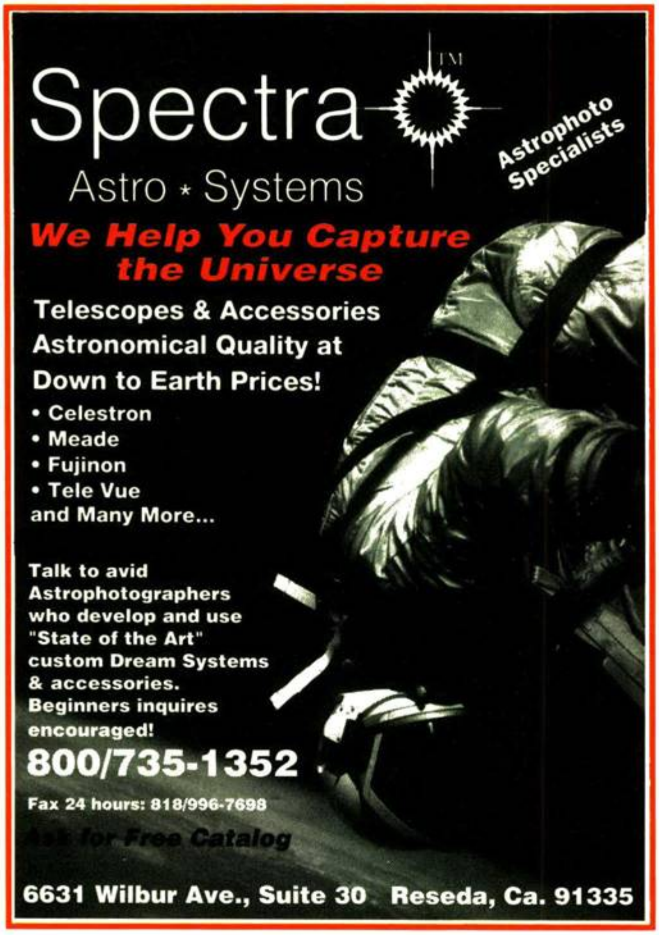
EXTENSION TUBES

1'' long 1¼'' OD thread-in extension	**12.00**
2½'' long extension (holds 1¼'' filters)	**16.00**
4½'' long extension for 1¼'' eyepieces	**$25.00**
3'' long extension for 2'' eyepieces*	**$26.00**
2'' long extension for 2'' eyepieces*	**$26.00**

VIEWING ADAPTERS

2''/1¼'' reducing bushing, threaded 48mm*	**$20.00**
2''/T-thread adapter, threaded 48mm*	**$25.00**
T-thread/1¼'' adapter	**$25.00**
F/10 2'' or 1¼'' eyepiece viewing adapter for Giant Easy-Guider	**$39.50**
Low profile star diagonal eyepiece holder	**$16.00**
Meade 2'' Diagonal/Giant Easy-Guider	**$39.50**

**Threaded to hold 48mm filters.*



Spectra™
Astro ⋆ Systems

We Help You Capture the Universe

Telescopes & Accessories Astronomical Quality at Down to Earth Prices!

- Celestron
- Meade
- Fujinon
- Tele Vue

and Many More...

Talk to avid Astrophotographers who develop and use "State of the Art" custom Dream Systems & accessories. Beginners inquires encouraged!

800/735-1352

Fax 24 hours: 818/996-7698

Ask for Free Catalog

6631 Wilbur Ave., Suite 30 Reseda, Ca. 91335

TOUR THE UNIVERSE AT LIGHT SPEED!

- Limited-Production Precision Telescopes
- Light-Weight Folding Design
- 16- and 20-Inch Models
- Highest-Quality Materials & Workmanship

LIGHT SPEED TELESCOPES, INC.
3991 Weld County Rd. 18, Erie, CO 80516
303-678-9547

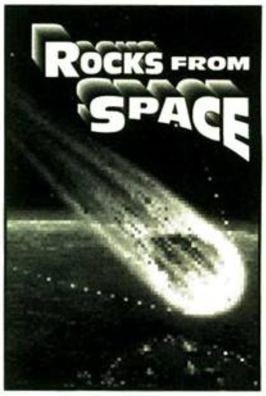
NEW

◆ *A lively and lavishly illustrated guide to meteorites, asteroids, and comets for everyone from the aspiring astronomer to the "science-impaired" layperson.*

Rocks from Space
Meteorites and Meteorite Hunters
O. Richard Norton
Illustrated by Dorothy Sigler Norton

To hold in your hand a piece of the solar system, a rock from space older than Earth itself—this is the allure of the meteorite. Hurtling through space from points unknown, these thunderstones crash-land on Earth and then remain to be found by rockhounds. *Rocks from Space*—for the rock collector, the stargazer, or the inquiring layperson—is the first nontechnical guide to the fascinating world of meteorites, asteroids, and comets. *Rocks from Space* tells the story of cosmic debris—the science, the superstition and folklore, and the tales of people who collect them.

464 pages • 6x9
over 200 photographs and illustrations, 33 in color
ISBN 0-87842-302-8 • paper $20.00



Call Today for a
FREE CATALOG
Toll Free
1-800-234-5308
Available 24 Hours

MOUNTAIN PRESS PUBLISHING COMPANY
P.O. Box 2399 • Missoula, Montana 59806
(406) 728-1900 • Fax (406) 728-1635

Golden Eclipse Memories

It was a hot and dry day over most of the United States on May 10, 1994. Eclipse Day was clear as a bell in the Plains, Midwest, and Northeast and marred by cloudiness over part of the Southwest — the exact inverse of the historical weather patterns. Most eclipse watchers got a pleasant weather surprise, and nearly everyone along the path of annularity, which stretched from Baja California to Western Africa, got a spectacular view of one of the century's last major solar eclipses.

"I just couldn't believe the excitement of eclipse chasing," says Penny Smith of Fulton, Illinois. "After years of reading about eclipses in exotic places I finally got the chance to see one close to home." Smith traveled to a spot between Rolla and Jefferson City, Missouri, and prepared for annularity. "At a roadside stop my husband Jerry and I had a number of visitors during the eclipse," she says, "and we happily shared our eclipse glasses with them. The visitors included workmen on a garbage truck who knew about the eclipse and were delighted to take a peek at the ring of sunlight. Few activities bring people together as astronomy does."

Some shadow chasers took longer trips in order to witness the event. Stephen A. Meeks and Roger Curry of the Northeast Florida Astronomical Society drove 1,100 miles to Wauseon, Ohio, to see annularity. "We met observers from Kentucky and North Carolina near our site," says Meeks. "The number of people who traveled significant distances was amazing."

German amateur Friedhelm Dorst journeyed to El Paso to view the eclipse and escaped cloudy weather in the area to capture a series of photographs. Californian Ralph Merletti watched from the parking lot of the post office in Canutillo, Texas, and delighted in crescents and rings of sunlight on the pavement, a phenomenon he had never before experienced.

There were those who chose an unlikely approach to viewing the event. Joel Harris, Dana Matula, and Mary Iverson of Burbank, California, traveled to Azrou, Morocco, to watch the eclipsed Sun sink into the Atlantic Ocean. "The observing conditions were ideal," says Harris. "The annulus was beautiful and terrifically bright — far too luminous to look at with the naked eye. As we watched the ring sink toward the watery horizon, we agreed that our trip was well worth the effort." Half a world away observers who made shorter trips thought the very same thing, satisfied with the beauty of one of nature's grandest spectacles. □

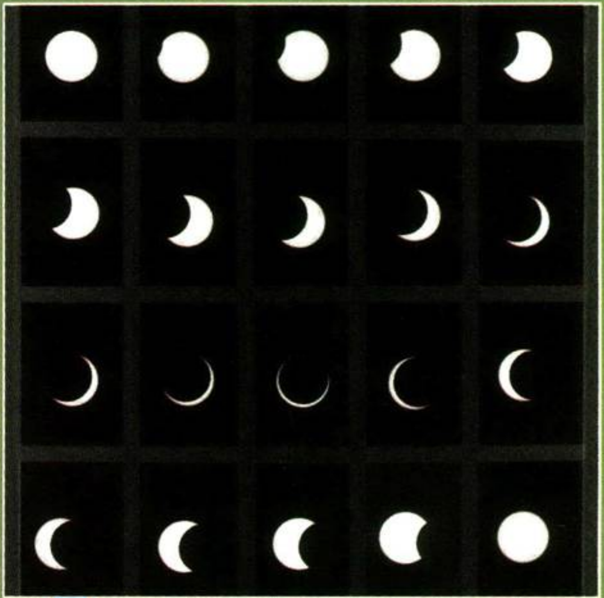
ASTRONOMY wants to hear about your observations of the sky. Send reports, sketches, and photographs to David J. Eicher, Reader Reports Editor, ASTRONOMY, P.O. Box 1612, Waukesha, WI 53187. Please label each photo with name, address, and social security number. You may send written reports via the Internet to 72000.2704@CompuServe.com

Annular Eclipse over Columbus, New Mexico

Composite image by Richard Levine (630mm lens at f/11 to record the Sun, foreground shot on Ektachrome 100; taken from Columbus, New Mexico)

Approaching Annularity

by Daniel Koehler (5-inch f/6 lens, Fuji Velvia film, 1/30-second exposure taken from Toledo, Ohio)

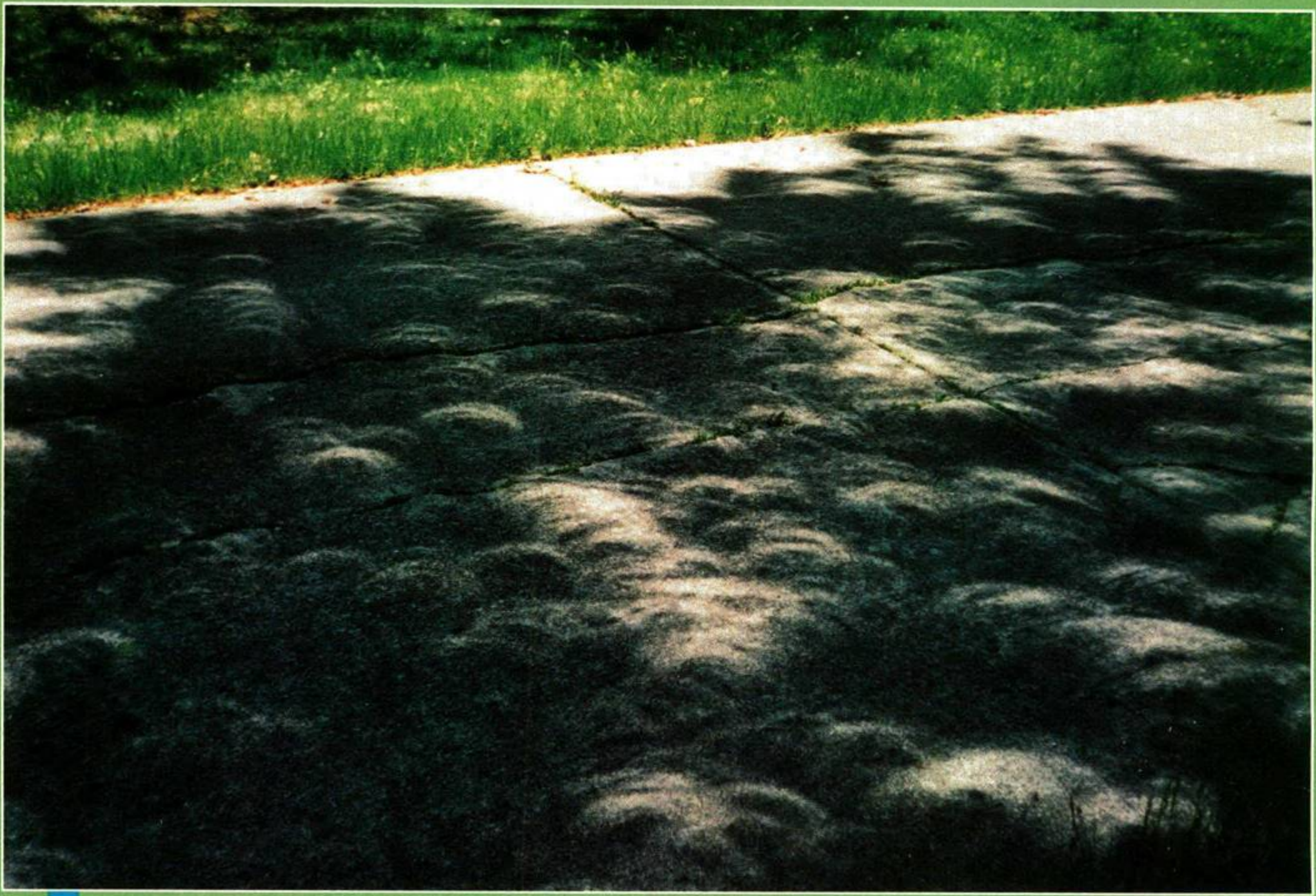


Ninety-four Percent from Des Plaines, Illinois

Composite image by Victor C. Rogus (5-inch f/9 refractor, images taken every 10 minutes from Des Plaines, Illinois)

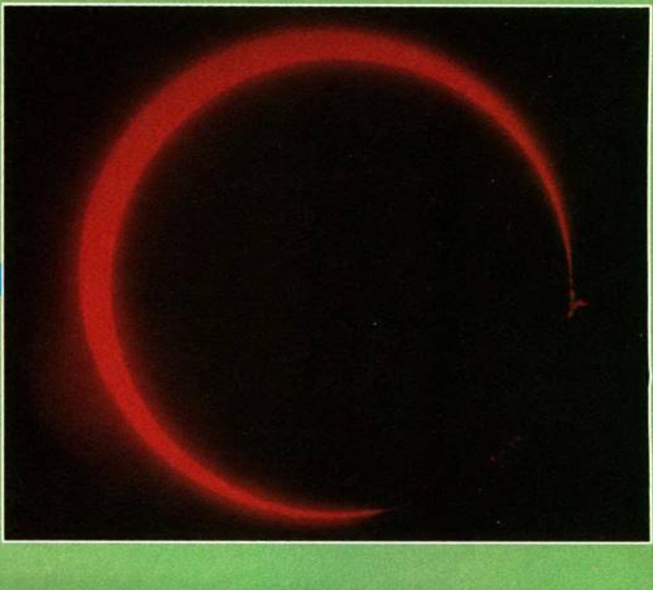
ECLIPSE STILL LIFE

The response to last May 10's annular eclipse was overwhelming — our offices bulged with photographs and observing reports. One of the finest composite images, perhaps inspired by Frank Zullo's article "Merging Land and Sky" (June 1994), is Mark Killion's elegant record of the eclipse photographed from Paris, Illinois (right). Killion's photo wins this month's $100 Best Astrophoto award.



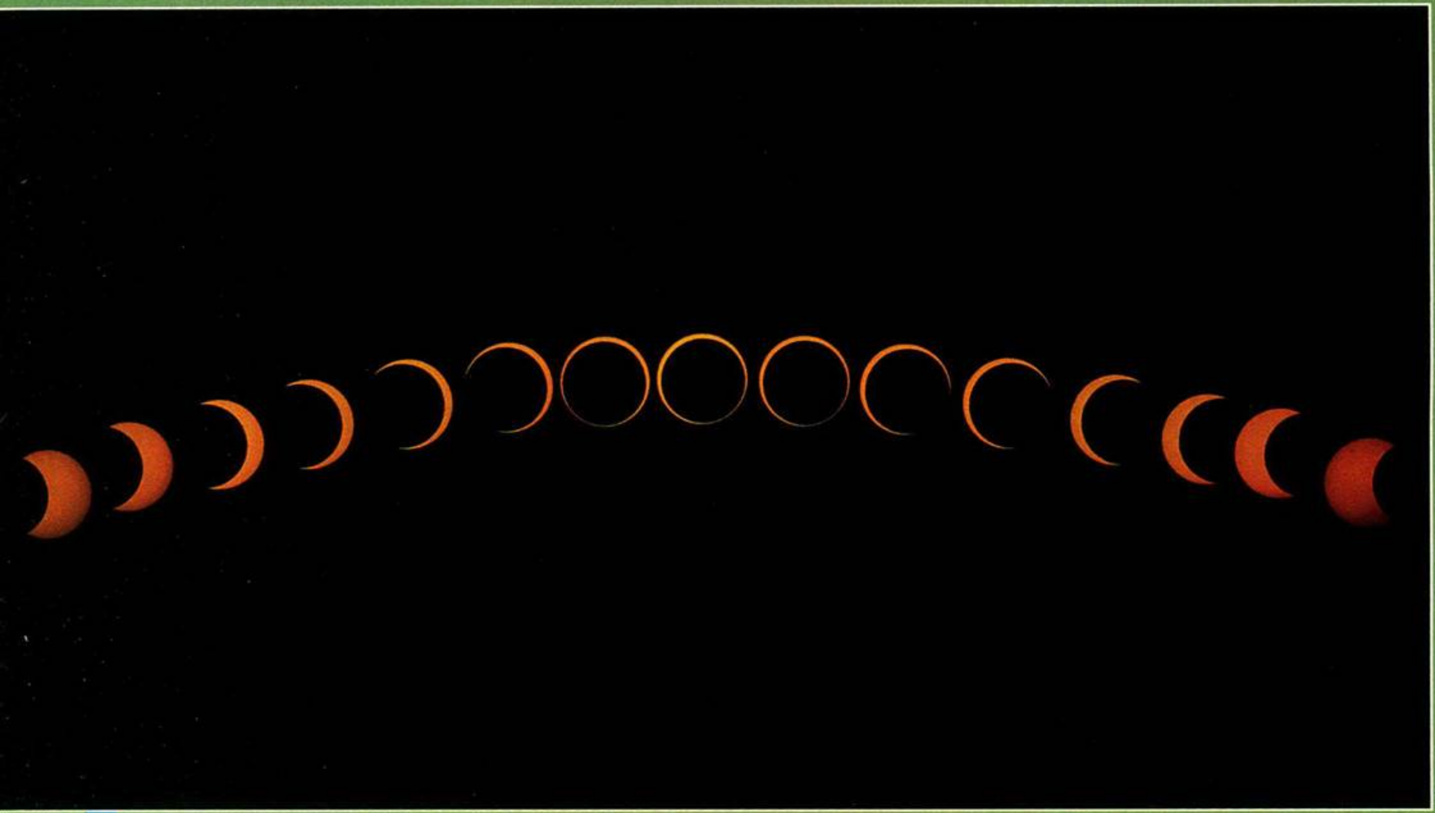
Crescents on the Driveway

by Nancy Eicher
(taken from Oxford, Ohio)



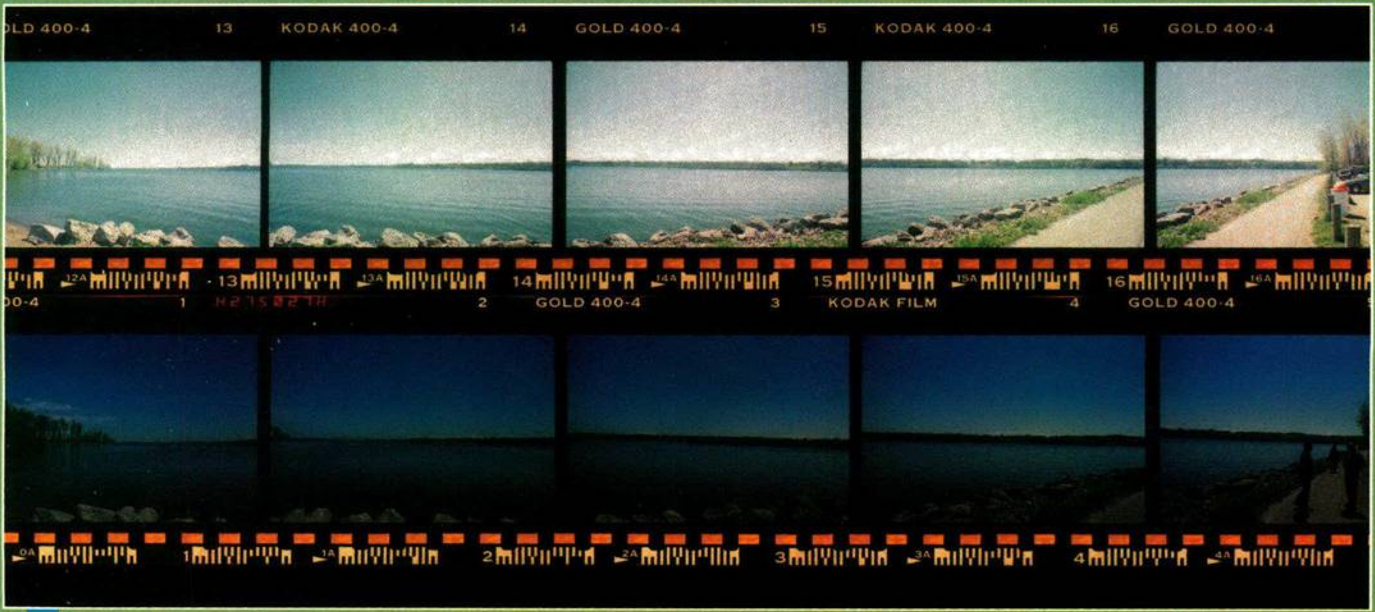
The Eclipsed Sun in Hydrogen-Alpha

by Jacques Guertin
(6-inch Maksutov-Cassegrain scope at f/64, hydrogen-alpha filter, Kodacolor 100 film, 2-second exposure taken from El Paso, Texas)



Golden Rings of Sunlight

Composite image by Mark Killion
(3.5-inch Maksutov-Cassegrain scope, Ektachrome 100 film, exposures ranging from 1/60-second to 1/4-second, taken from Paris, Illinois)



Shadow over the Land

by Douglas R. Gilchrist
(Multiple images show terrain before eclipse (top) and during eclipse, using 28mm lens at f/11 and holding all exposures to 1/250-second, taken from Clinton, Pennsylvania)

ASTRONOMY'S MARKETPLACE

Welcome to the MARKETPLACE section in ASTRONOMY Magazine. These pages are specifically designed to be an affordable and highly effective way for you to market astronomy-related products or services. Call **Debbi Simon** at **800-558-1544, ext. 636** to place your advertising message here.

ANNOUNCING A NEW PUBLICATION

SETIQuest™

SETIQuest is a new quarterly print/electronic mail (E-mail) periodical containing news, technical information, and tutorials devoted to bioastronomy and its subset, SETI (Search for Extraterrestrial Intelligence.) *SETIQuest* is published for professionals, serious amateur astronomers and individuals curious about this fascinating field of observation. *SETIQuest* fills the need for a specialized astronomical publication devoted exclusively to the on-going search for evidence of life in the Universe. Such evidence could be intentional or inadvertent signals of other civilizations; such evidence could be found in spectral signatures of biological activity on non-solar planets or in the interstellar medium. *SETIQuest* is written and edited for the scientifically literate individual taking part in the progress of our technological civilization, with articles by amateur and professional scientists. *SETIQuest* includes information about hands-on observational programs that can be carried out by individuals and groups of amateur astronomers at radio and optical wavelengths. *SETIQuest* is filled with articles covering topics such as:

- Tutorials about bioastronomy and SETI
- Microwave or optical SETI as practiced by amateurs
- Do-it-yourself participation in bioastronomy and SETI activities
- Book reviews
- Regular commentary on issues relevant to SETI and bioastronomy:
  - SETI and the political milieu
  - Philosophical issues regarding the prospects of success and failure in the search
  - SETI as a parable of science versus pseudo science.
  - Publications Watch: summaries of recent scientific/general publications relevant to SETI

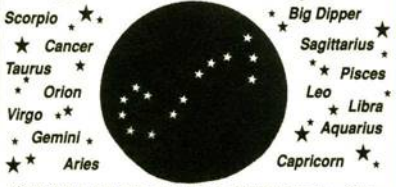
For your FREE issue of *SETIQuest* (Volume 1, Number 1), send us your postal address by fax, e-mail, or conventional mail to:

***SETIQuest* Inquiries, Department AS**
Helmers Publishing
174 Concord St.
Peterborough, NH 03458-0874

Phone (603) 924-9621
FAX (603) 924-7408

Internet E-mail:
sqinqas@pixelacres.mv.com

Hang your favorite constellations on your wall!



Glow in the dark stars are inlaid in midnight blue sky. (Glow varies with exposure to light.) Two legend cards are included with each plaque. One is affixed to the reverse, the other is shipped loose and can be kept as a handy reference. Plaque is approximately 16" dia. & ready to hang! 14 constellations available... Order Today!

$40 US + $5 US (s&h US) = $45 US ea. (Allow 2-4 weeks)

Send check to:

Bob Horrell Custom Woodworking, Inc.
615 Marawood Dr., Woodstock, IL 60098
Larger plaques & star tables also available!

Put a comet in your ear!
The Comet Update Line.

Most nights, there are 3 comets of mag 11 or brighter, and 8 of mag 16 or brighter.

How many did you see last night?

Call 1-900-725-4789 for current comet positions and all new discoveries. ∗ *Updated every Tues & Fri, 2 pm MST*

$2.50/min, avg. 3 min.
(max. amt. all options $12.50)

Tchtn. ph. req. If under 18, must get parental perm.

Gibeon Designs PO 65863 Tucson AZ 85728 602/887-2122

METEORITES

ROBERT A. HAAG METEORITES

All varieties.
Authenticity and satisfaction guaranteed.

Send $5.00 for a 64 pg, full-color, all-new *Field Guide of Meteorites.* Cost refundable on first order.

To fax: (602) 743-7225
P.O. Box 27527, Tucson, AZ 85726

ECLIPSE SHADES™

Solar Viewing Glasses

Custom
Imprinting
Available!
ECLIPSE SHADES

Safe for direct solar viewing! Eclipse Shades™ provide the ultimate in protection from harmful Solar Radiation. Lenses made of Optical Grade, Neutral Density 5 Mylar, filter out 100% of Ultra-Violet, 100% of Infra-Red, and 99.999% of Visible Light.

Quality Paper Eyewear & Specialty Optics
Rainbow Symphony, Inc.
6860 Canby Ave. #120, Reseda, CA 91335
1-800-821-5122 FAX (818) 708-8470

ATTENTION MEADE LX200 OWNERS!

Now available – Pilot Base Mounting Plate

Enables quicker, safer set-up on tripod. Eliminates difficulty in finding center threaded rod hole and damage to bottom of drive base. Scope cannot slide off during bolt-up procedure. High quality appearance machined from solid aluminum plate. (Patent pending) **$215.00 + shipping**

NMA **New Mexico Astronomical • 505-864-2953**
834 N.Gabaldon Rd. • Belen, NM 87002

A-OK! THE WINGS OF MERCURY

The year is 1962...
The place is Cape Canaveral, Florida...
The eyes of thousands turn skyward as a column of flame soars to the heavens...

"All systems are A-OK!"

- An ultra-realistic simulation of America's first manned spacecraft, Project Mercury!
- Based on the original NASA specifications!
- Reproduces *all* switches, gauges & systems!
- Full color, digital sound, including CapCom!
- Actual NASA checklists & flight plans online!
- For the Apple Macintosh!

Call: 1-800-9 SPACE 4 or write.

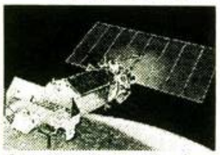
Do you have the right stuff to fly the **real thing**?

INNOVATIVE TECHNOLOGIES! 156 Seventeenth Avenue
Brick, N.J. 08724-1814

SunTracker

Laminated 365-day graphical sun rise/set chart customized for your location.
Accurate to 2 min. **$7.50** ck/m.o.
Urania Scientific
P.O. Box 983, Alma MI 48801

SPY ON THE EARTH



See *live* on your PC what satellites in orbit see

Capture *live* breathtaking images of the Earth for fun or profit. Zoom in up to 20X. Send $39 check or M.O. ($45 air, $50 overseas) for our *fantastic* 12 diskette set of professional quality copyrighted programs (IBM type) that does satellite tracking, image acquisition, image processing, 3-D projections and more. Direct reception from the satellites guaranteed worldwide without a satellite dish. Schematics included for interface. For FREE information log-on to our bulletin board anytime at: (718) 740-3911.

VANGUARD Electronic Labs
Dept. T, 196-23 Jamaica Ave.
Hollis, NY 11423 Tel. 718-468-2720

REMOTE CONTROL ASTRONOMY CENTER BEING BUILT IN OREGON FOR AMATEURS

YOU'LL CONTROL LARGE 18, AND 25 INCH SCOPES, CCD CAMERAS AND IMAGING SOFTWARE; ALL LONG DISTANCE .... FROM YOUR COMPUTER. ENTIRE PROJECT AND USERS INFORMATION PACK JUST $ 8.00 + 2.00 S & H FROM: JAMES JOHNSTON PO BOX 91417 ; PORTLAND,OR ; 97291-0417

ASTRONOMY'S
MARKETPLACE

FREE ONLINE ASTRONOMY CLASSIFIEDS

Buy/Sell used scopes, eyepieces, accessories, etc. Post ads immediately. See ads the second they are posted.

The Pegasus Classifieds
Online: 1-303-296-9214 (BBS) 294-0239
Voice (Denver Tax Software): 1-800-326-6686

ECLIPSE TOUR

INDIA — OCTOBER 24, 1995
Presented by The Alberta Science Centre
and the Royal Astronomical Society
of Canada, Calgary Centre.
From Canada: 1-800-661-1335
From U.S.A. Collect: (403) 531-1250
FAX: (403) 262-2649

Let's Talk Travel Ltd.

Dallas Remote Imaging Group

Astronomy BBS

- *Astronomy Databases*
- *Satellite Imagery Real -time*
- *Satellite Prediction Programs*
- *NASA Daily Updates*
- *Internet Space Newsgroups*
- *Thousands of Space Images*
- *Internet Worldwide Access*

BBS: (214) 394-7438

Voice: (214) 394-7325

Internet - info@drig.com

FREE LIST OF AVAILABLE SPECIMENS

METEORITES

- **New Miles IIE Silicated Iron**
- **Pallasites and more**

Authenticity and Satisfaction Guaranteed

BUY • SELL • TRADE

Southwest Meteorite Lab
P.O. Box 95 • Payson, AZ 85547

FAX
602-474-2474

NASA Photo
FOR SALE

We've got an easier way to sell your scope

The Starry Messenger astronomy classified shopper is the largest nation-wide listing of the telescopes and accessories currently for sale by amateur astronomers.

Advertise free - pay a 4% commission when successful
Subscribe - $23 for 12 issues
Save $$$ on used equipment
Over 20,000 sales since 1986
500+ current ads each month

The Starry Messenger PO Box 6552-A Ithaca, NY 14851
(201) 992-6865 FAX (607) 277-0018 CompuServe 75020,3120
MC / VISA / DISC Canada - Mexico please send $29 US funds

AstroSystems

Truss Tube Kits & Components

Including: Primary Mirror Cells, Spiders, Focusers, Sec. Holders, Tube Clamps, Altitude Bearings, Teflon, Ebony Star, Kydex

Free catalog US; foreign $2.00 refunded w/first order

5348 Ocotillo Ct., Johnstown, CO 80534/303 587-5838

CENTRAL CAMERA CO.

230 So. Wabash Chicago, IL 60604

1-312-427-5580
1-800-421-1899
(OUTSIDE 312 & 708)
FAX: 1-312-427-1898

WE SELL BOTH NEW & USED PHOTO EQUIPMENT AT GREAT LOW PRICES EVERY DAY! – *OUR 95th YEAR*

MON-FRI: 8:30-5:30 SAT: 8:30-5:00 (CT)

SPECTACULAR!

Earth Science Supply Catalog

Fossils • Rocks and Minerals
Dinosaurs • Environment • Ecology
Oceanography • Archaeology
Astronomy • Videos • Biology
Chemistry • General Science

NEW 1994 CATALOG!

For Earth Science Catalog send $2.00 (refundable)

Dino Productions, P.O. Box 3004, Dept. EA, Englewood, CO 80155

BRASS TELESCOPES

in miniature
Scale Models • Custom Models
Have Your Telescope Captured in Miniature.
Write for FREE Brochure.
b.crist miniatures, 597 Harman Road,
Halifax, PA 17032-9798

Bargain Books

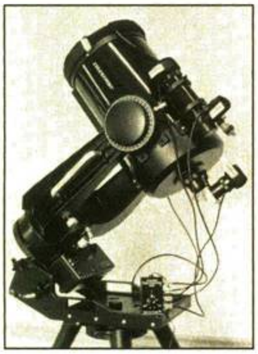
Save up to 80% on publishers' overstocks, remainders. Thousands of books, from yesterday's best sellers to rarely seen titles. **Science and Astronomy,** Photography, History, Biography, Nature—over 40 subject areas. Write for **FREE CATALOG.**

Hamilton Box 15-963, Falls Village, CT 06031

EXPERIENCE THE DEEP SKY!

STARSPLITTER TELESCOPES

HIGH QUALITY ALT-AZ
NEWTONIAN TELESCOPES 12.5" - 30"
COMPLETE SYSTEMS OR INSTALL YOUR OPTICS
FOR INFORMATION CALL OR WRITE
805-493-2489
3228 RIKKARD DR. • THOUSAND OAKS, CA 91362



The Kendrick Dew Remover System

A unique, high quality and temperature controlled heating system that REALLY WORKS.

We have heaters for telrads, eyepieces, finderscopes, guidescopes, secondary mirrors, main objectives up to C14s, binoculars and cameras.

For a free brochure and price list, please send SAE to:

Jim Kendrick Studio
2775 Dundas Street West
Toronto, Ontario • Canada M6P 1Y4
Orders only: 1-800-393-5456
For technical information call:
416-762-7946
Fax: 416-767-4112

ASTRONOMY'S MARKETPLACE

Illustrated in full-color! Innovative design!

Graphic Dark Sky Calendars

★ Large 11"x17", 1-year wall calendar
★ Custom to your lat/long, any month/yr.
★ Eye-catching for Home/Office/Gift

$14.95 plus $2 s/h

Gibeon Designs, P.O. 65863, Tucson, AZ 85728
602-887-2122 (eves. MST, M-F)

WILDERNESS TRAVEL

TOTAL ECLIPSE
October 19–25 1995

- Thar Desert Eclipse Camp in Rajasthan, India
- Highland Eclipse Resort in Thailand
- Angkor Wat in Cambodia

510-548-0420 • 800-368-2794

NEW VIDEO RELEASE

Our Universe from Birth to Death

This video takes you back through computer animation to a time before the creation of this universe. Then watch how it all happened in slow motion in a way never shown before. The way it all happened is called the Silent Conversion.

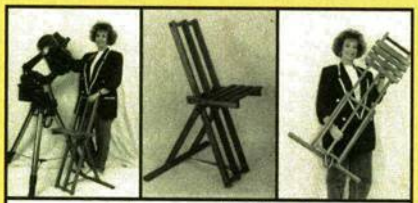
This Silent Conversion Theory is new, exciting and realistic!

How our solar system evolved is also shown with a fly-by of each planet.

This 30 minute video is very informative and costs only $22.95

To place your order,
Call 1-800-248-3493 24 hrs.
Energy Controls, Inc.
1355 Park Road
Chanhassen Mn 55317

We accept credit cards from Visa, Mastercard & Discover



Observer's Chair

☆ Hand Crafted - Solid Oak
☆ Easy storage - Lightweight (under 10 lbs.)
☆ 36" Tall - Adjustable seat moves 18" to 36" (Max. Weight is 250 lbs.)

$69.95 (Plus $10 shipping in the U.S.)

K.C. Woodsmith P.O. Box 75033
Wichita, KS 67275-0033 Phone: (316) 721-1566

Neat and new! Likely the simplest device for its functions.

SUNNYDIAL™ sun path mapper/solver

For *any place, date, & time*, this planisphere maps the sun's path on 5x6 in. base and solves basic(solar energy & direction, sunrise...) & amusing problems. Easy/advanced uses: numerical info, basic ed, science/math fun. Let's find the sunny side! One device & booklet, $7, incl.postage, MI tax; 2-$12.50; 3-$18. Refundable. Order(check), inquiry(SASE): Sunny Ideas; File A; P.O. Box 1784; Midland, MI 48641-1784

GOOD MIRROR? *POOR IMAGES?*

LASER COLLIMATE YOUR SCOPE
FOR MAXIMUM PERFORMANCE
SIMPLE, QUICK AND HIGHLY ACCURATE

NOW ONLY $129.95 CHECK OR M.O.
OR SEND S.A.S.E FOR MORE INFO
KENSINGTON OPTICS 1246 EAST 35 ST.
BROOKLYN N.Y. 11210

Celebrate the Oldest Science.

Choose from our diverse selection of original designs screen printed on the finest 100% cotton tees and sweatshirts. We customize for clubs and organizations. **Dealer inquiries welcome.**

- COPERNICUS
- BRAHE/KEPLER
- GALILEO
- HERSCHEL, W.
- M-81
- OMEGA CENTAURI
- MAGELLANIC CLOUDS
- HORSEHEAD NEBULA
- ROSETTE NEBULA
- TRIFID NEBULA
- LUNAR COMMEMORATIVE
- EARTH
- 18TH CENTURY TELESCOPE
- 19TH CENT. TELE. (TO 1850)

FREE color brochure

Main Sequence
P.O. BOX 3882
SCOTTSDALE, AZ 85271

1-800-NITE SKY

BUSINESS OPPORTUNITY

Earn up to $500 per day doing Astronomy programs with a Starlab portable planetarium! Initial investment as low as $8950.00. Call or write for information package and other help starting your own business with Starlab.

Learning Technologies, Inc.
59 Walden St. • Cambridge, MA 02140
Ph: 800-537-8703 • Fax: 617-547-2686

METEORITES!

Irons. Stones. Stony-irons. Tektites.
Quality display and study specimens.
Space jewelry, books, slides.
Authenticity guaranteed.
Color Catalog $2.

Bethany Sciences
P.O. Box 3726-A
New Haven, CT 06525

CATCH A FALLING STAR!

(203)393-3395

Buy a Star ★ Name a Star

On the exclusive
MSAS Star Atlas
to be placed in our future observatory & science center.

Starting at only $30.00 !

Receive a certificate of record and more.

Free brochure.

(909) 336-1699

Mtn. Skies Astronomical Society
Box 1169 - Lake Arrowhead, CA. 92352

VISA/MC accepted

Science Connection is a North America-wide

SINGLES NETWORK

through which people interested in science or nature can meet.

For info write: **Science Connection, PO Box 188, Youngstown, NY 14174** ***or call:*** **1-800-667-5179.**

NOVAGRAPHICS
Space Art Gallery

COMET ART

ORIGINALS PRINTS POSTERS
from

Robert McCall Kim Poor Alan Bean
Michael Carroll Bob Eggleton
Don Davis Joe Tucciarone
John Foster *& more*
prompt shipping *framing available*

RARE & VALUABLE AUTOGRAPHS
We have astronaut & cosmonaut autographed collector's editions, with signatures of the original Mercury astronauts, the Apollo-Soyuz crews, and prints by astronaut-artists Alan Bean and Alexei Leonov.

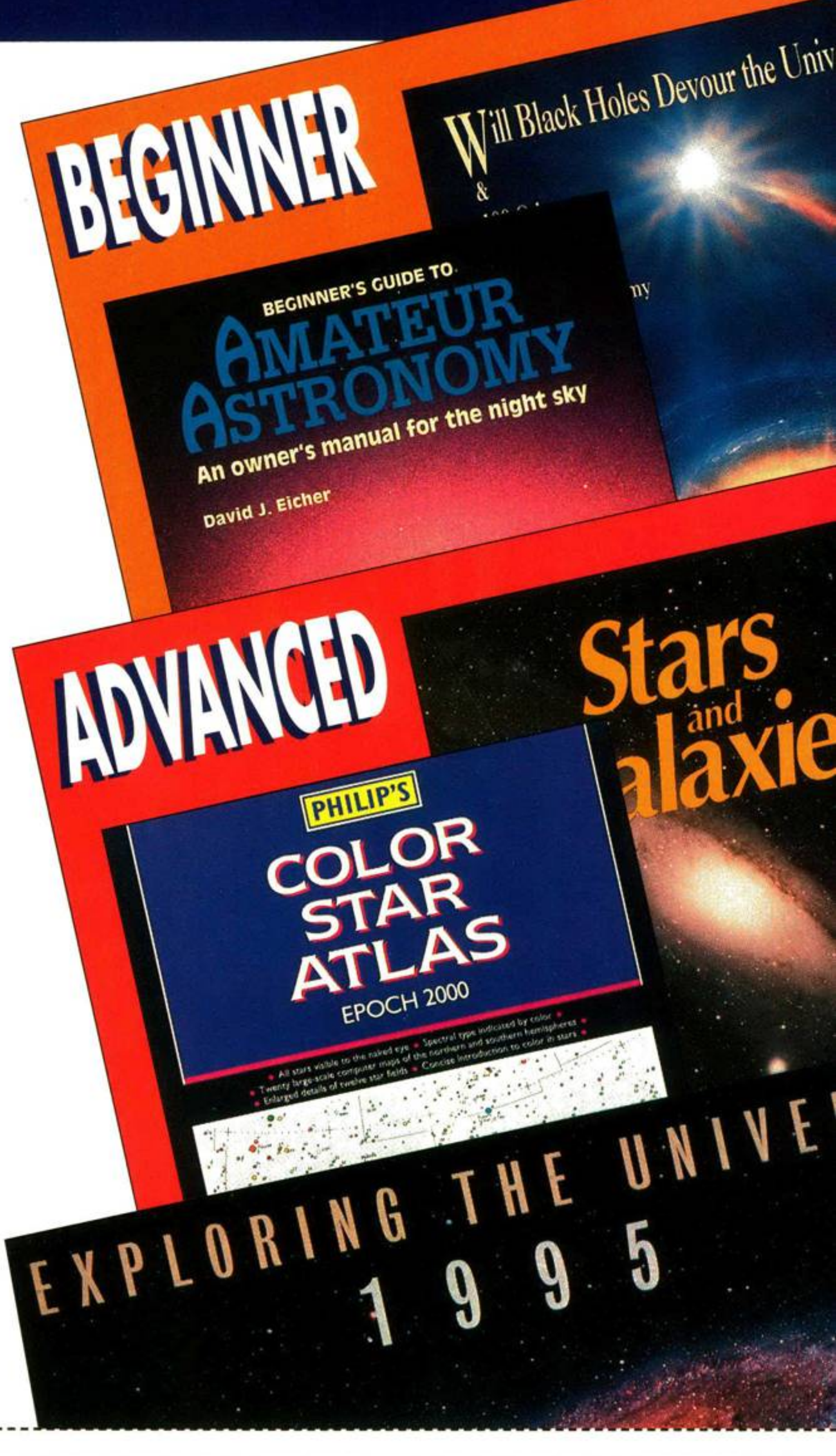
$ 3 for our colorful catalog
$4 Canada, $5 International airmail U.S. funds

charge a catalog on your credit card

1-800-727-NOVA

NOVAGRAPHICS CATALOG #11
BOX 37197-Q TUCSON, AZ 85740

"From the Publishers of ASTRONOMY."


BEGINNER
Will Black Holes Devour the Univ
&
ny
BEGINNER'S GUIDE TO
AMATEUR ASTRONOMY
An owner's manual for the night sky
David J. Eicher
ADVANCED
Stars and
alaxie
PHILIP'S
COLOR STAR ATLAS
EPOCH 2000
All stars visible to the naked eye • Spectral type indicated by color • Twenty large-scale computer maps of the northern and southern hemispheres • Enlarged details of twelve star fields • Concise introduction to color in stars
EXPLORING THE UNIVE
1995

Will Black Holes Devour the Universe?
Why do stars twinkle? Will the Sun ever burn out? What's the difference between a meteor and a meteorite? Melanie Melton has collected 101 of the most-asked astronomy questions and answered them with explanations that are clear and to the point. 7 ¼ x 9 ¾, 104 pgs., 6+ illus., softbound.
#18541 .... $14.95

Beginner's Guide To Amateur Astronomy
This owner's manual for the night sky gets beginners off to a great start! David Eicher identifies the best objects visible with the naked eye, binoculars and a small telescope. Helpful appendices describe and list solar system objects, the Messier catalog of deep sky objects, telescope manufacturers, and astronomy clubs. 7⅜ x 9⅝, 176 pgs., 80 color 80 b&w photos, softbound.
#18540 .... $19.95

Stars and Galaxies: Astronomy's Guide to Exploring the Cosmos
A collection of 36 deep-sky articles from ASTRONOMY *magazine. The brightest, most beautiful, and most challenging denizens of the Milky Way Galaxy and beyond. The articles form a handy guide, explaining general deep-sky observing, galaxies, stars, and clusters as well as bright and dark nebulae. By David J. Eicher. 8½ x 11, 192 pgs., 129 b&w and 110 color photos, 98 illus., 34 charts, hardbound.*
#18536 .... $29.95

Color Star Atlas
This easy to use atlas shows the colors of all naked-eye stars. Twenty wide-angle charts locate all stars down to a magnitude of +6.55, plus deep-sky objects such as galaxies, nebulae, and clusters. By John Cox and Richard Monkhouse. 11⅛ x 15¼. 40 pgs., softbound.
#18038 .... $19.95

Exploring the Universe Calendar 1995 *- useful for all star-gazers! Let the excitement of space and astronomy hang in your home or office every day! Breathtaking photos and artwork on every page. Each month includes information on when to view meteor showers, eclipses, the planets, and phases of the Moon. And there's plenty of room to schedule your earthly happenings as well! From the editors of* ASTRONOMY *magazine. Printed on heavy high-gloss stock, 14 x 11, 13 color photos.*
#68079 .... $10.95

To Order Call
toll free
1-800-533-6644
24 hours a day.
For faster service call Monday – Friday
8:30 am – 5:00 pm CT.
Please have your credit card ready.
Fax 414-796-0126.
Outside the U.S. and Canada call
414-796-8776.

Use this coupon and mail to: Kalmbach Publishing Co., Dept. A0910, 21027 Crossroads Circle, P.O. Box 986, Waukesha, WI 53187-0986. **Include for postage and handling:** U.S. add $3.00 4th class (or $4.50 UPS continental U.S. only); Canada add $5.00, other foreign add $10.00. Maryland and Wisconsin residents add 5% sales tax to total. Canadian orders add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change. On a seperate sheet list each product title and item number you are ordering. ***Enter total amount on this form.**

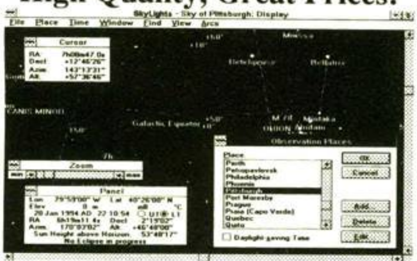
Name ______________________
Address ______________________
City ______________________
State, Zip ______________________

* Total Enclosed $__________ **(Please include postage and taxes.)**
Credit Card #______________________
(We accept: American Express (min. $15), MasterCard or VISA)
Expiration Date __________ Phone # __________
Signature ______________________

Dept A0910

Astronomy Software

High Quality, Great Prices!


SkyLights - Sky of Pittsburgh: Display
File Place Time Window Find View Arcs
Cursor
Zoom
Panel
Observation Places
OK
Cancel
Add
Delete
Edit
Daylight saving Time

☐ **SkyLights**™ Explore the Sky through Windows! For any date from 4700BC to 9999AD see Sun, Moon, planets and stars, plus all Messier objects and hundreds of selected NGC and IC objects (galaxies, clusters, etc.). Skylights is very easy to use and takes full advantage of the Windows environment, such as printer support and moveable information windows. Track an object across the sky using time steps you specify. Get detailed information by clicking on an object, such as RA & Dec., Alt & Azm, geo & heliocentric Lat & Long, rise and set & more. Database of world cities lets you pick any observing site, add your own. Database of sky events like eclipses, occultations, etc. is included, just click and observe. Has three information windows you can toggle on or off. Zoom in or out. Many controls to customize program the way you like! IBM, Windows 3.1 **$89.95**

☐ **Ceres**™ Calculates ephemeris & plots sky path for all asteroids or minor planets. Almost 6,000 included in database, with names & #'s, orbital elements, magnitudes, etc. Developed by world's authority for minor planets, the Institute of Theoretical Astronomy of the Russian Academy of Sciences. Plots asteroids against the sky using 200,000 reference stars. See orbits plotted around the Sun. IBM EGA/VGA, harddrive, 7 meg. **$159.95**

☐ **Satellite Pro**™ - Earth satellite tracking for high accuracy ephemeris & simultaneous propagations & for optical & radio tracking. Flies up to 200 satellites simultaneously. Comes with nearly 4,000 satellite orbital element sets; info for free updates. Displays Earth ground tracks, sky maps with stars, planets, Sun, Moon. Satellite RA/Dec, slant range, range rate, intersatellite range, phase angles, height, altitude & sky velocities, AOS time & pass duration. IBM VGA, harddrive **$149.95**

☐ **AstroCalc Super**™ Input time, date & lat./long. & get for Sun, Moon & planets: Right Asc./Dec., Alt/Azm, Ecliptic Lat./Long., Angular size, Fraction Illum., Elongation, Rise/Set Times, Distances from Sun & Earth, Sidereal Time, Twilight Times, Helio and Geocentric Data. Automatic repetitive calculations(solar/planetary positions or any other data for every hour or day, etc.). Output as ASCII text file or to printer. Plots of Sun, Moon & Planets on screen or laser/dot matrix printers. Helio & geocentric plots of longitude & distance or latitude & distance, RA & Dec. or altitude & azm. IBM EGA/VGA **$89.95**

☐ **AstroCalc for Windows**™ Functions similar to Super version but uses MS Windows interface. IBM **$99.95**

☐ **Gravitator Pro**™ Calculates gravitational forces on bodies like stars and planets & determines orbits. See paths plotted, vary scale of view & orientation, use 3D option. Input initial conditions or use examples provided. Save systems to run later. Display distances between bodies & forces between pairs of bodies, more! Print to dot or laser. IBM EGA/VGA, **$129.95**

☐ **StarPilot**™ Pilot your own personal starship through the universe! Explore our own real Solar System & its planets & satellites as well as 6 imaginary star systems with planets, some inhabited. Hundreds of different bodies and over 50 space stations & ground bases give you a long term high adventure! Accurate visual & flight dynamics of spaceflight developed by Ph.D. astronautical engineer. Head out to the Moon, orbit Saturn, land on Mars or go far beyond! IBM EGA/VGA **$59.95**

☐ **SunTracker Super**™ Plots solar eclipses on variable scale world maps, plus numerical data. Specify center of map & size by giving lat. & long. limits. Central line of totality is plotted & lines for north/south limits of visibility. Country boundaries & major rivers plotted. Cities can be added to maps. Output to screen or printer. IBM EGA/VGA, harddrive **$89.95**

☐ **SunTimes**™ Monthly or yearly sunrise & sunset tables for any year and location. Output to screen or printer. Twilight times, maximum altitude of Sun, azimuth of rise/set. IBM **$29.95**

☐ **MoonTimes**™ Similar to SunTimes but for the Moon. Includes rise/set times, phase & azimuth at rise/set. IBM **$29.95**

MasterCard **Order Today!** VISA

☎ **1-800-533-6666**

24 Hrs, 7 Days - FAX Orders to 412-422-9930
For Info or in PA Call 412-422-6600

Order by phone, FAX or mail. Check, M.O., or credit card (give # & exp. date). Add $4 shipping($6 outside US). In PA add 6%. Give disk size, $1 extra for 3.5". Join thousands of satisfied customers in over 120 countries. Fast shipment, friendly service.

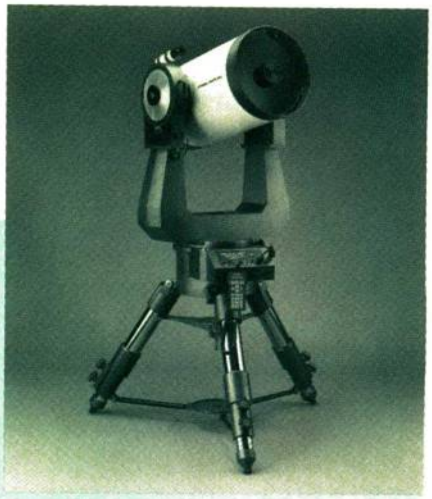
Zephyr Services

The Leading Astronomy Software Publisher

ZS
1900 Murray Ave. Dept. B
Pittsburgh PA 15217
FREE Catalog, Call or Write

Our 14th Year

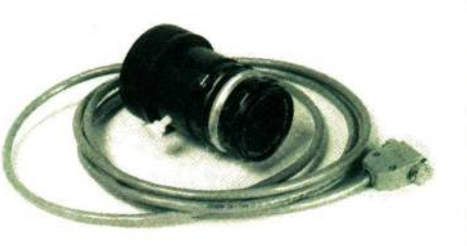
NEW PRODUCTS



16-inch Schmidt-Cassegrain Telescope

Meade Instruments has added a 16-inch f/10 SCT to its LX-200 line of computer-controlled, altazimuth telescopes. The telescope breaks down into four components for field transport: optical tube assembly, fork mount, drive base, and field tripod. With its field tripod, the scope weighs 313 pounds. The locations of 64,359 stars and deep-sky objects are incorporated into the telescope's computer memory, and the scope can slew to them using a GOTO command. The drive can slew at six different rates: 2x and 16x sidereal, and 1°, 2°, 3°, and 4° per second. Periodic-error-correction software yields a tracking accuracy of 5 arcseconds. Ports on a drive base panel allow for personal computer and CCD-imager hook-ups. Two built-in cooling fans ventilate the optical tube assembly. Also available are permanent altazimuth and equatorial piers and, for long-exposure astrophotography, a field derotator that plugs into the control panel.

Meade Instruments Corporation, 16542 Millikan Ave., Irvine, CA 92714, (714) 756-2291, fax: (714) 756-1450. $14,950.



ST-5 CCD Imaging Camera

At the heart of the ST-5 (shown here attached to a 50mm lens, not included with the camera) is a CCD chip with 10-micron square pixels in a 320 by 240 format that provides a light-gathering area of 7.8 square millimeters. The camera has a 14-bit dynamic range (16,384 grey levels), a 400 to 1000 nm spectral response, selectable detector temperature, and an electronic shutter. Built-in software can run the camera in autoguiding or track and accumulate modes. The software can also take photometric and astrometric measurements and perform image enhancement. For color photography, a CFW-6A filter wheel is available.

Santa Barbara Instrument Group, 1482 East Valley Road, P.O. Box 50437, Santa Barbara, CA 93150, (805) 969-1851, fax: (805) 969-4069. $1,800.

Weatherproof Binoculars

Bausch & Lomb has expanded its weatherproof Discoverer Series to include 7x42 and 10x42 binoculars. Both designs have silver and magnesium fluorite-coated roof prisms and are nitrogen purged and hermetically sealed. A one-piece rubber coating covers the outside of both designs. The binoculars offer eye relief of 20mm and 14mm, respectively. Both are sold with a black nylon carrying case and come with a limited lifetime warranty.

Bausch & Lomb Sport Optics Division, 9200 Cody, Overland Park, KS 66214, (800) 423-3537. 7x42: $901.95; 10x42: $1,049.95.

BLOWOUT SALE

CELESTRON COMPUSTAR 14

See your Celestron dealer for complete details of this never before offered **Compustar 14** package which includes the fork mounted telescope, tripod, equatorial wedge and AC power supply.

Large aperture performance in a portable package —14"— 3910mm fl (f/11) Schmidt-Cassegrain.

To experience large aperture optics with a completely computer driven telescope, consider the **Compustar 14**. This time proven instrument is of the highest quality and is a joy to use.

See objects you've never seen before. Spend your valuable observing time observing. Over 8,000 objects (including the Messier catalog, a computerized list of NGC objects and a reference catalog of notable stars) are included in the Compustar's micro-computer memory. With quickness and precision you can locate — and track — an object. Select your viewing horizon, brightness, category of object and length of observing time per object.

Not an add-on, this totally integrated system gives you all the features you need: automatic polar alignment assistance, automatic high-speed slewing and pointing, full pilot control via optional joystick, precession of coordinates to date of observation, compensation for atmospheric refraction and much more...

Includes 7x50 finderscope, 2 oculars –1¼", 2" diagonal and Starbright® coating group.

CELESTRON SOLAR FILTERS

Celestron's Solar Skreen® solar filters transmit .0001% of visible light, allowing direct observation of the Sun. With them you can see sun spots and mottled areas known as granules. In addition to reducing the intensity of the Sun's visible light, they also block 99.9999% of invisible infrared light so you can observe the Sun safely.

The material used to make these filters is a precision engineered, strong aluminized polyester film known as Mylar. Each filter consists of two sheets of Mylar. A layer of aluminum is vacuum-deposited on each piece of Mylar. These two coated surfaces are placed against each other to protect them from scratching and other abuses. The material is very thin, about .0003" which is about 1/10th the thickness of human hair. Because it is so thin, Mylar offers superior performance as compared to thicker filters. Mylar filters are also less expensive and much ***more durable*** than old style glass filters. (The Solar Skreen® solar filter is covered under U.S. patent #3.897.140).

- ***More durable than glass filters***
- ***Better resolution***
- ***Sharper image***

Mylar is a very flexible substance by nature. And, when mounted in the filter cell, it is quite wrinkled. Don't be fooled by the way the filter looks. The best resolution is obtained when the material is slightly relaxed or wrinkled. It does **NOT** have to be stretched tight.

In addition, the color of the solar image looks different than with other filters. With the aluminum coating, the solar image is a cool, pale blue color. A more true color image can be produced with the appropriate eyepiece filter, either a #21 or #23A.

Models available for most Celestron Telescopes.

CELESTRON® *LIGHT YEARS AHEAD OF THE COMPETITION*

Celestron International • 2835 Columbia Street • Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

El Paso Annular Eclipse Video

Spectacular speeded-up time-lapse shots of the Moon precisely covering the Sun from the centerline of the Annular Eclipse. Video taken from El Paso, Texas, in perfect weather. Includes unusual scenes of Hydrogen prominences disappearing slowly behind the limb of our Moon. Only $25.

Roger W. Tuthill
11 Tanglewood Lane, Mountainside, NJ 07092

The French Connection

l'astronomie
la maison de

L'Excellence En Astronomie

QUÉBEC

Vente et Location

- Telescope
- Livres
- Posters
- T-Shirts
- Accessoires
- Cours Privés

(514) 279-0063

8056 St-Hubert
Montréal, P.Q. H2R 2P3

CCD IMAGING EQUIPMENT™

- Cameras
- Filter Wheels
  Manual & Remote
- ALL CCD Filters
- Flip Mirrors
- Beam Splitters
- 1.25, 2-in. & T-mounts

Equipment for
ALL CCDs
AND visual use

Filter Wheel w/Flip Mirror

MURNAGHAN™ Instruments
1781 Primrose Ln., W. Palm Beach, FL 33414
Phone: 407-795-2201 • FAX: 407-795-9889
Internet: murni @ bix.com
BBS 407-795-0979

Reach the world's largest audience of astronomy enthusiasts in

ASTRONOMY®

1-800-558-1544

NEW PRODUCTS

Gyro-stabilized Monocular

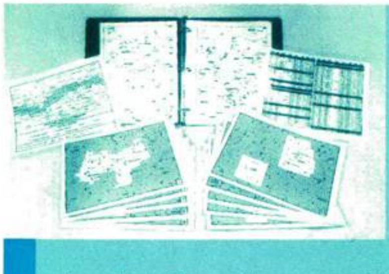
Imported from Russia, this 7x57 monocular is stabilized by a built-in gyro that runs off an internal battery or through a power cord that connects to an external 12-volt power supply. Included is a battery charger and a waterproof high-impact plastic carrying case.

Advanced International Technologies, Inc., Suite E206, 1130 Ten Rod Road, North Kingstown, RI 02852, (800) 945-9103, fax: (401) 294-7960. $850 plus $12 shipping and handling.

Lightweight, Rigid Refractor

Australian telescope maker Donald Abbes is selling a 6-inch f/15 achromatic refractor optical assembly that utilizes a double skinned, octagonal tube made of strong, lightweight material. Running the entire length of the scope's interior, the inner tube has a set of baffles to reduce stray light. Space between the inner and outer tubes is filled with fiberglass insulation. The eyepiece-end of the assembly incorporates still another interior tube intended to insulate the rest of the scope from heat given off by the observer. The exterior is finished with three coats of high-gloss blue enamel. The overall refractor weight, including the dew cap, is 34 pounds.

Donald Abbes, 2 Gymea Court, Keysborough, Victoria 3173 Australia, phone: 011-613-03-798-6275. $1,700 plus shipping.



OGTU-17 Observer's Guide to the Universe

This guide is a compendium of 31 8x10-inch laminated charts that cover 52 constellations, and shows the location of 100 Messier and 400 Herschel objects, along with complete data on each object. Also included are seasonal charts showing the 21 brightest stars and an all-sky constellation chart. The guide comes with a silk-screened binder.

Astronomical Innovations, P.O. Box 14853, Lenexa, KS 66285, (913) 894-5775. $39.95.

This department presents new product announcements issued by their manufacturers. Product information is as supplied by the manufacturers or distributors. All prices are suggested retail. Suppliers should send their product announcements to the attention of John Shibley.

FOR SALE: THE BEST SPACE IN THE UNIVERSE.

A Turner Home Entertainment Exclusive:
Call 1-800-690-8686
now to order your copy of "Moon Shot" – and get the inside story from outer space.

GREAT VALUE:
$19.98
FOR DOUBLE CASSETTE VOLUME
THE GREATEST ADVENTURE OF MANKIND
DOCUMENTARY
MOON SHOT
The Inside Story of the Apollo Project
VHS
TURNER HOME ENTERTAINMENT

"Moon Shot" explores the most fascinating subject in the universe with never-before-seen footage and never-before-told stories. Featuring Alan Shepard, the first man in space, and Deke Slayton, one of the original seven NASA astronauts, "Moon Shot" is exciting and spellbinding.

Make space in your video collection for it. At only $19.98 for a double-cassette volume, this is a once-in-a-millennium offer.

Call 1-800-690-8686 to order your copy today.

Not rated. Approx. 189 mins.
Catalog #3144.
Photography courtesy of NASA.

"Moon Shot" is also available wherever videos are sold.

Artwork and Design ©1994 Turner Broadcasting System, Inc. All Rights Reserved.

ODYSSEY TELESCOPES
Seeing the *real* Universe

NEW! ODYSSEY 8" f/7! BEST BUY AT $239.50!

ADVANTAGES:
- SUPERB LUNAR-PLANETARY VIEWS
- STRONG DOUBLE STAR SPLITTER
- 1/8 WAVE OPTICS, GUARANTEED!
- LOWEST PRICED 8"!
- ALL ODYSSEY 8" f/4.5'S FIT MOUNT!

FREE INFORMATION
- ODYSSEY GUIDE
- OWNER COMMENTS
- FREE TELESCOPE TESTER
- DOBSONIAN INFO.
- COULTER OPTICAL NEWS
- PRODUCT LIST

ASK FOR IT!

8 INCH - $275.00

"On the Moon and Jupiter, the Odyssey 8 showed as much detail as several 8" Schmidt-Cassegrains nearby."
David McGough, Millington, N.J.

"It is worth twice what I paid, but please don't raise the price. I want to get my son one in a few years."
Tom Johnston, Boulder, Colo.

10.1 INCH - $345.00

"Careful star-testing of the 10.1" Odyssey Compact I received last March and of the 10.1" my neighbor Doug Barnes picked up in mid-October suggests a high level of quality control which is astonishing. Diffraction patterns are virtually interchangeable, and both scopes show textbook optical results (both in-focus and out-of-focus)."
Lee Johnson, Coquitlam, B.C. Canada

13.1 INCH - $575.00

"In amateur astronomy for over 35 years and I have seen my share of all kinds of telescopes, good and bad. To say the least, the Odyssey 1 outperforms any thing that I have seen!!"
Richard Ziegler, Maumee, Ohio

"There is not another telescope of equal size in our club that can touch the clear image and ease of operation that Odyssey 1 provides."
Mark Davenport, Pinellas Park, Fla.

17.5 INCH - $1150.00

"I've only had a chance to view once so far, but am thoroughly thrilled with it. Viewing from a (Santa Barbara, Ca.) residential front yard, the Orion Nebula was indeed a treat – reddish tinges on the predominating green, with many subtle wisps and lanes very clear. The Andromeda Galaxy was surprisingly bright, as was its companion."
David Broad, Santa Barbara, Ca.

EASY TO ORDER...Phone or mail your order in today. Visa/MasterCard accepted. All telescopes are shipped freight charges collect. All mirrors are shipped prepaid in the contiguous U.S.A. No sales tax on out-of-state orders. Phone orders Mon.-Fri. 8 am-4:30 pm local time.

Call 1-909-659-4621

- **30 days returnable**
- **30 days exchangeable**
- **2 years materials and workmanship**

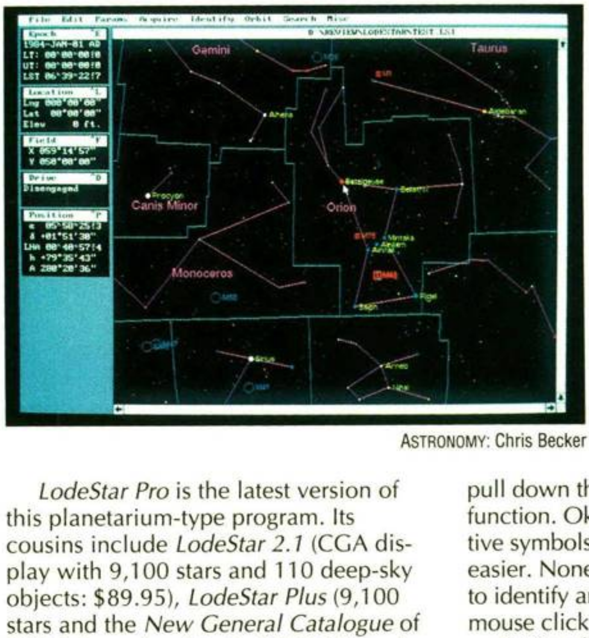
Coulter Optical, Inc.
P.O. Box K • Idyllwild, CA 92549

"OPTIMUM OPTICS AT MINIMUM COST SINCE 1967"

ASTROBYTES

Star Guide

LodeStar Pro (1.02)
Zephyr Services, 1900 Murray Avenue, Pittsburgh, PA 15217, (800) 533-6666, fax (412) 422-9930. Price: $259.95; $289.95 for GS version that can read optional *Guide Star Catalog* CD-ROMs. Minimum requirements: 80286-based computer, 2 MB of memory, DOS 3.0, mouse, VGA display (VESA compliant), and 3 MB of hard disk space. Recommended: 80386-based computer, 4 MB of memory. Optional databases — SAO catalog (total of 259,000 stars; requires 5.5 MB of hard disk space): $29.95; *Guide Star Catalog* (total of 16 million stars; requires a CD-ROM drive): $69.95.



Epoch
1984-JAN-01 AD
LT: 00°00'00!0
UT: 00°00'00!0
LST 06°39'22!7

Location
Lng 000°00'00"
Lat 00°00'00"
Elev 0 ft.

Field
X 059°14'57"
Y 058°00'00"

Drive
Disengaged

Position
α 05°58'25!3
δ +01°51'30"
LHA 00°40'57!4
h +79°35'43"
A 280°20'36"

ASTRONOMY: Chris Becker

LodeStar Pro is the latest version of this planetarium-type program. Its cousins include *LodeStar 2.1* (CGA display with 9,100 stars and 110 deep-sky objects: $89.95), *LodeStar Plus* (9,100 stars and the *New General Catalogue* of 7,840 deep-sky objects: $149.95), and *LodeStar Plus II* (the same as *Plus* version but can also add a custom database and use an optional 259,000-star SAO catalog: $199.95, or $229.95 with SAO catalog).

Pro stands above these versions with an improved user interface and some new features. For example, it adds 37 comets and 200 asteroids to the standard 9,100-star and 7,840-object deep-sky databases. Unlike its low-end versions, *Pro* can access the Hubble *Guide Star Catalog* with its GS version. It supports over 300 printers, can store a star map as a PCX-format file for use in other programs, and allows display and printing of CCD images.

Unlike other planetarium-type programs, *LodeStar* will calculate star and planet positions back to 9999 B.C. It matches the forward prediction range (A.D. 9999) of most programs. The program will display constellation lines and boundaries, the local horizon, twilit sky regions, and coordinate grids. A red screen version can replace the normal display to preserve night vision at the telescope. For custom sky maps, a palette editor changes the colors of labels, lines, stars, the sky background, and the symbols of planet and deep-sky objects. Numerous font sizes and types permit customizing object labels.

An Acquire feature locates an object by its right ascension and declination or by name from lists of constellations, common names of stars and deep-sky objects, planets, and comets. Acquire also finds by catalog number asteroids, stars in the SAO and HD catalogs, and deep-sky objects in the Messier and NGC catalogs. Identify, the counterpart of Acquire, is also available. For each object identified, an information window gives the object's name, rise and set times, magnitude, right ascension and declination, and altitude and azimuth. For deep-sky objects, this feature also provides the diameter, object type, and an encoded description. Information for stars includes spectral type, color, Flamsteed or Bayer designation, and the SAO and HD catalog numbers. The difficulty with Identify is that it requires knowing the object type in order to pull down the proper menu within the function. Okay, objects do have distinctive symbols on the screen to make this easier. Nonetheless, users should be able to identify an object with just a simple mouse click.

Setting the time as either a Julian date or the more common Gregorian date is easy. Changing locations is a bit more difficult: All locations must have their latitude and longitude entered. A list of cities would make this task easier. My usual gripe about manuals applies to *LodeStar's* — it really needs an index to make finding information on specific features easier.

LodeStar Pro lets you do everything you would expect from a planetarium-type program — search for objects, identify them, and find eclipses and planetary conjunctions. The accuracy of its planetary positions is good. But it seems pricey compared to other programs of its class. — *Dave Bruning*

Moving?

Don't forget your magazine subscription!

Print your old and new addresses below. For faster service, include the account number found on your mailing label. Allow six weeks for delivery.

Old Address

Name ____________________

Address ____________________

City ____________________

State ____________ Zip ______

Account no. ____________________

New Address

Address ____________________

City ____________________

State ____________ Zip ______

Date effective: ____________________

Mail to: Kalmbach Publishing Co.,
21027 Crossroads Circle, P.O. Box 1612,
Waukesha, WI 53187-1612 • Fax 414-796-0126.

AS894

Want your astro images published?

We are... assembling a collection of **amateur astrophotographs** to publish in a major work on astrophotography. Send us your personal best and/or most interesting! Submissions may be conventional emulsion-based shots (prints or slides) OR CCD images (color or black & white) OR videotape (VHS or Hi8).

We are... interested in any astronomical phenomenon **you** have photographed: deep-sky objects, planetary bodies, the Moon, the Sun, meteors, comets, auroras, Comet SL-9 impacts, etc. They must be images you've taken through a telescope, or piggy-backing on one, or just using a camera and lens on a tripod.

Send us... *copies* of your prints, slides, or video (originals cannot be returned), or CCD images (TIFF, PCX, GIF, JPEG; on DOS diskette), and if you would like, a biographical note & self- photo, for inclusion in the publication.

Tell us... the image's technical details (to the best of your knowledge), including: the object's name, imaging date, type of telescope and its size and mount, camera and lens type, film type, length of exposure, filters, image processing details, site data, weather data. Submit any comments for quotation you feel are important.

We will... fully accredit you for all chosen work *and* offer you a special price on the final publication in appreciation.

All submissions must be postmarked by December 15, 1994.

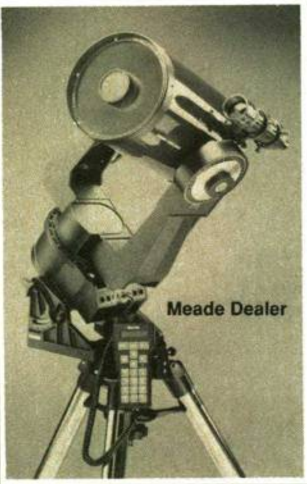
We are ...

WOLF 359

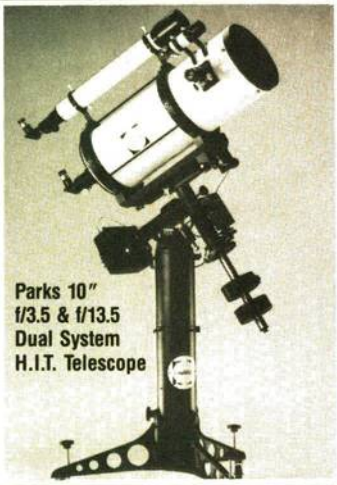
P.O. Box 138
Kinburn, Ontario K0A 2H0
Canada
Phone: 613-839-5304
Compuserve: 76437, 1014

Scope City

Largest, Most Complete Optical Supermarket in the World

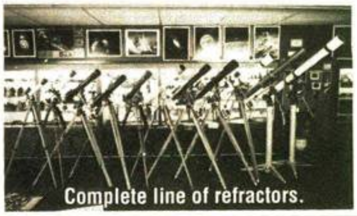


Meade Dealer



Parks 10″
f/3.5 & f/13.5
Dual System
H.I.T. Telescope

Complete line of TeleVue products.



Complete line of refractors.

WORLD'S LARGEST SELECTION OF BINOCULARS

SAVE UP TO 45%
ON TELESCOPES, BINOCULARS & ACCESSORIES.
EXPERT HELP.

See the latest innovation in astronomical equipment

MAIN OFFICE
679 Easy St.
Simi Valley, CA 93065
TEL: (805) 522-6646

SHERMAN OAKS, CA
14324 Ventura Blvd.
TEL: (818) 789-5805

SIMI VALLEY, CA
679 Easy St.
TEL: (805) 522-6646

SAN DIEGO, CA
4766 Clairemont
Mesa Blvd.
TEL: (619) 277-6686

COSTA MESA, CA
3033 S. Bristol
TEL: (714) 957-6900

SURPLUS STORE
COSTA MESA, CA
3033 S. Bristol
TEL: (714) 957-6900

SCOPE CITY / MAIL ORDER
P.O. Box 440 • Simi Valley, CA 93065
TEL: (805) 522-6670
FAX: (805) 582-0292
Catalog package $7 (refundable with purchase).
Free price list.

BUY • SELL • TRADE • SERVICE

Image The Home Planet

Every day a fleet of Earth orbiting weather satellites image our planet. These images are relayed over shortwave radio and transmitted directly from the satellites. SSC makes the hardware and software that will let you connect your IBM PC compatible computer to a shortwave, or other radio, so that you can receive these images.

Whether you are ready to study global warming, track storms, or just see if it is worth packing off to your favorite dark sky site, SSC's weather facsimile products are for you.

At $99, our entry level system includes the radio to computer interface, software, manual and tutorial audio cassette. Software and interfaces for direct satellite reception start at $250. All packages include our image processing software with advanced features like false colorization, time lapse frame looping, zoom, scroll pan and many other features.

PC HF Facsimile $99

Complete shortwave systems including radios, antennas, software and interfaces are as little as $399. Complete systems for direct satellite reception start at $499. Call or write for our free product catalog.

Software Systems Consulting
615 S. El Camino Real, San Clemente, CA 92672
Tel: (714) 498-5784 • Fax: (714) 498-0568

International
Dark-Sky
Association

You can help:
- conserve energy
- reduce air and light pollution
- save the night skies for everyone to use and enjoy.

To learn about *light pollution, energy waste, light trespass,* and related issues, or to join, ($20 basic membership), write to the non-profit **International Dark-Sky Association,** 3545 N. Stewart Ave., Tucson, AZ 85716 U.S.A.

THE NEWEST WAY TO WATCH THE WEATHER!

New Product!
TEMPERATURE
14
64.3°
DAVIS
New Low Price $195!

Haven't you always wanted a weather station? The Weather Wizard III combines all the most requested features into one incredible package!

FEATURES INCLUDE:
- Inside & Outside Temps
- Wind Speed & Direction
- Time & Date
- Wind Chill
- Alarms
- Highs & Lows
- Rainfall Option
- Instant Metric Conversions
- Optional PC Interface

New **Larger Display** New **Compass Rose**

Order today:

1-800-678-3669

M-F 7 a.m. to 5:30 p.m. Pacific Time • AY646Z
FAX 1-510-670-0589 • M/C and VISA
One-year warranty • 30-day money-back guarantee

DAVIS INSTRUMENTS
3465 Diablo Ave., Hayward, CA 94545

HOME-DOME™
THE AFFORDABLE OBSERVATORY

- True Rotating Dome
- 6, 10, or 15 ft. Diameter
- Wide Slot Openings
- Easy Assembly
- All Fiberglass
- Complete Systems Priced from $1950

Satisfaction guaranteed by

TECHNICAL INNOVATIONS, INC.
22500 Old Hundred Road
Barnesville, MD 20838
301-972-8040

Call or write for FREE brochure

NEW SOFTWARE

Pixfix
Bruce Johnston Computing, 7764 Tull Court, Waterford, MI 48327, (810) 666-2186. Price: $29.95 plus $3 for shipping. Minimum requirements: IBM PC-compatible computer, DOS 3.0, VGA display, and 512 KB of memory.

Low-cost image processing is possible with *Pixfix.* This program allows users to calibrate an image, display it, zoom in on features, determine the intensity of an individual pixel, view a histogram of image brightness, and blink between two images. Scaling functions permit changing the brightness and contrast of an image, while filters allow sharpening and unsharp masking. Other functions retouch bad pixels. Fifteen practice images come with *Pixfix.* The program can read and manipulate images in the following file formats: raw, CCD, LNX, PIX, SBI, and TIF. Included with *Pixfix* is another program, *Pixshow,* which displays images just as a slide projector would. It can show one image at a time or automatically display a sequence of images. The programs come with a 60-day, no-questions-asked guarantee.

Interactive Ray Trace (5.1)
Parsec Technology, 4323 North 30th Street, Boulder, CO 80301, (303) 447-0071. Price: $198. Minimum requirements: 80386-based computer, Windows 3.1, and 1 MB of memory. Also available for UNIX and VMS environments.

In *IRT,* fast 32-bit processing and the graphical Windows interface combine for powerful tracing of light rays through optics. Users control the program through three types of windows: editing, program control, and graphical displays. A series of simple commands defines the shapes and positions of the optical elements used. Instead of users having to construct elaborate files with coordinates and directions of rays to be traced, *IRT* uses simple object and pupil definitions. The program will trace up to 100,000 rays (16 MB of memory required), and can use lenses, mirrors, gratings, flats, ellipsoids, toroids, masks, knife edges, and newly developed holographic spherical gratings. To help analyze the image produced by the optics, it will display spot plots, spot profiles, rms blur, and modulation transfer functions. A glass library permits trials using different types of optical glass, and a focus finder will automatically locate the focus of a design. The manual contains many useful examples to help users quickly get acquainted with this program and its abilities. ☐

★ BEST VALUES - LOWEST PRICES! ★ ★ TELRAD ★ PARKS ★ BUSHNELL ★ BRANDON/VERNONSCOPE ★ SCORPIUS ★ ASTRO SYSTEMS ★ SKY PUBLISHING ★

NEW C8-C11
ULTIMA 2000
COMPUTER - GO TO TELESCOPE - CALL!

LOWEST GUARANTEED LISTED PRICES!

ES Edmund Scientific
RKE Eyepieces 1 1/4" $41

4 1/4" Astroscan 2001 $297
COMPLETE LINE - CALL

CELESTRON GIANT............$349
11X80mm - 15X80mm - 20X80mm
Free NEBULAR filters

9X60 R/A ILL.
FINDER + BKT.
$139. MEADE

SEE MEADE AD
Authorized Meade Dealer
WE ARE A FULL LINE MEADE DISTRIBUTOR

SEVEN DAYS A WEEK 10 to 10

CELESTRON $AVE

NOTICE: LOWER PRICE FOUND? JUST GIVE A CALL!

TELESCOPES SCH/CASS.
C5, (AC/DC) **C8** Classic,
GPC8, **C8 +** Computerized,
C8+, Ultima C8,
CG11, **C14**, **CG14** ....**Lowest Prices**

LATEST MODELS WITH CROWN GLASS

TELESCOPES REFLECTORS
C4.5, 7.9" f4(RFT) .... Call For **BEST Price!**
TELESCOPES REFRACTORS
First Scope 80, 60,90F, GP 102, GP102F, **Great Prices!**
SPOTTING SCOPES
C90 all models, S50, C60RC, 20x60 WP, 20x60 Ed-WP, 30x60 WP, S80, S80+, C5, C8, 500Mmm. f 5.6 .... **CALL**
BINOCULARS - PRICED TO SELL!
Monoculars 5x20, 8x25, 6X16
Mini 8x25, 8x22, 10x25, 8x24PP, 10x24PP
UNBEATABLE PRICES
NATURE 7X35, 7X50, 8X42
Pro 8x30, 7x50, 10x50, 12x50, 8x56, 9x63, 8-24x50 Zoom
ULTIMA 8x32, 7x42, 10x42, 7x50, 10x50, 8x56,
ED SERIES 6.5x44, 9.5x44
Water Proof 8x21, 8x30
Giant 16x70, 11x80, 15x80, 20x80, 20x100 mm, ... **CALL**

OPTICAL TUBE ASSEMBLIES	
C8" Optical Tube Assem. Star Bgt.	$695
GP 102........$595, C11......CALL, C14	$3999
ULTIMA EYEPIECES	
5, 7.5 12.5, 2xBARLOW (1 1/4")	ea $70
18mm, 24mm, Ultima 1 1/4"	ea $74
30.........$87, 35.........$103, 42mm	$99
45 60mm 2".....ea $158, 80mm	$233
OR 6, 7, 9, 12mm (96")	ea $35
KE 10mm 16, 18 25 30 40 (96")	ea $29
PLOSSL OCULARS **NEW CELESTRON SERIES**	
1 1/4" 7.5, 10, 17, 26mm...$46 . 40mm PL...	$52
(.96) 7.5, 10, 17, 26mm PL...	$42
Zoom 6.5-18, 1 1/4" ORTHO.	$113
25mm K 1 1/4" Multi-Coated	$35
4,5,6,12 Ortho (Multi-Coated) 1 1/4"	ea $49
Zoom OR 8 4 21mm 1 1/4" ONLY	$88
18 25mm 2" SPECIAL PURCHASE	ea $74
REVOLUTIONARY LANTHANUM EYEPIECES -LV SERIES - STATE OF THE ART - RARE EARTH GLASS -	
2.5 mm, 4mm, 20MM, 25MM, 1 1/4"	$102
5mm, 6mm, 9mm, 10mm, 15mm.....$95, 30mm., 2"	$130
Coma Corrector Photo-Visual 1 1/4" - 2"	$168
Micro Guide Eyepiece	$145
6mm ILLUM-Reticle 1 1/4"	$154
Adapter 2" to 1 1/4"	$13

T-RINGS	
(State Camera Make Model) All	$10 EA
ACCESSORIES	
AC Adapter (PEC)	$21
Accessory Case	$43
Barlow Lens 2x96" (Deluxe).....$24, 2.5 x	$24
Barlow Lens 1 1/4" Short type (NEW)	$55
Barlow Lens 2x2" m/c (Giant)	$69
Binocular Tripod Adapter	$14
Car Batt. Adapter Ultima (PEC)	ea $19
Car Window Mount	$29
Carrying Case - Powerstar 8 Custom ULTIMA	$138
Counterweight Bar Assem -8" .... $58 11"	$63
Counterweight Set - 8" (Standard) $48, C5	$55
DC Inverter (110V)	$73
Drag Erect Image - 45° 96" .... $42 45° 1 1/4"	$41
45° 96" to 1 1/4" DIAGONAL	$43
DEC Motor (PEC) 8/11, Ultima-Powerstar, Classic 8	$99
DEC Motor C4.5 and SP MT	$59
Deluxe Lat Adjuster (DLA) C8	$30
Dewstar (Lens Shade - 8")	$24
Advanced Astro Master (ATM) (SP-FORK)	$399
Drive Corrector - Heavy Duty	$358
Drive C8 Quartz Sing Axis (C8 - Classic)	$195
Quartz Dual Axis (C8)	$219
Expanding Bushing - 96" to 1 1/4"	$14
Filter (All Colors) 2" (Eyepiece)	ea $19
Filters #1A 8 12 15 21 23A 25 38A 47 56 58 80A 82A 96ND 50% 96ND 25% 96ND 13% Polar	ea $10
Filter Sets (Set of 6) .... $59 (Set of 12)	$119
Filter - Series 5 or 6 (6 ea. in Set)	$49
Filter Adapter - 96" .... $11 1 1/4"	$15
Finderscope 8x20 for C90-erect image....$54 BKT	$12
Finderscope 5x24 STG ...$29 6x30	$32
Finder Bracket (Quick Release) 8X50	$45
16x70R/A w/pol III GIANT FINDER	$189
7x50................$62, 7x50 III POLAR AXIS	$135
R/A w/Polar Align Reticule - 8x50 Ultima w/BKT	$154
Focus Motor - C8, Classic 8, PWR STAR	$99
Image Corrector - .96 18mm Eyepiece	$15
Large Accessory Ring (LAR) C90	$21
LED Flashlight	$12
Lens Shade - C90......$53, C5....$48, C8......$24 C11	$138
LPR Filter(Nebular #2.....$129, #5	$79
#7.....$89, "A"....$54, "B"...$79, C"...$75, "D".(Bin.)	$85
Motor Drive-for C4 5 w/Dr Single Ax.-SP (DC)	ea $158
Motor Drive S A (AC) Pol/Sp C4.5, SPC6, SPC8	$88
Motor Drive w/Dr. Dual Axis SP (DC) & GP	$238

Multiple Ocular Holder 96"	$62
MFFT 55 (Multi function focus-tester)	$133
Photo Tripod Adapter 8" (Opt Tube)	$50
Photographic Tripod Deluxe Slow Motion Controls	$39
Piggyback Mount 8".........$31, C5.....$55 11 14	$54
Piggyback Mount SPC 80 SPC6, SPC 102	ea $21
Polar Axis Finder w/Illum (for C4 5, C6, C80 SP)	$68
Polorizer Set (.96) (Variable)	$31
Polarizing Filter Set - 1 1/4" (Variable)	$42
Porro Prism - 965	$39
Radial Guide Assy Off Axis	$110
RFA (Rich Field Adap) f5	$89
Refractor Accessory Ring	$18
Reducer/Corrector Lens f6 3	$115
Reducing Bushing = 1 1/4" to 96"	$16
Filter Set - Series 5 (six) .... $49 Series 6 (six)	$57
Skylight Filter Dust Seal (5/8/11,14)	$34
Solar Filter - C90 C102 C4 5	$63
5" Off Axis - C11.....$109, C8 ...$98 C60 C80	$38
Sky sensor computer (SP-GP)	$695
Star Diagonal (.96)	$21
Star Diagonal 1 1/4" w/Multicoatings	$38
Star Diagonal (Mirror) 2" Deluxe Adjustable (PRO)	$218
Star Diagonal 2" (Mirror)	$120
Stereo Binocular Viewer	$429
Super Polaris Half Pier + (GP)	$112
GREAT Polaris Mt & Tripod	$599
T-Adapter C90, C5, C8, C11, C14	ea $22
T-Adapter - C90........$29, S-80	$24
T-C 16mm Adapter	$28
Spotting Scope Tripod........$94, Mini Tripod	$28
Tele Extender- Deluxe.....$42, Tele Extender	$22
TeleExtender - Refractor-Newtonian	$43
ALT. EZT. MOUNT TRIPOD (NEW)	$269
Tripod - Adjustable C5, C8.....$219 mini	$27
C8 Tripod (Oak) $195 11/14	$468
VSP (Vibration Suppression Pads)	$38
Visual Back - 1 1/4" (Eyepiece holder)	$26
Wedge - C8.....$85 Heavy Duty 8".....$198 11/14	$368
Wedge UII (Heavy Duty)	$359
PUBLICATIONS - BOOKS	
Owners Manuals, Acc. Catalog	ea $9
Binocular Buyers Guide Book by Alan Hale	$6
Sky Maps............$11 (Quantity Price)	ea $10
Star Atlas (North & South) 2000.0..$19 Planisphere	$6
Photography with your telescope	$6
MISCELLANEOUS	
Lens Caps........ea 50¢ Accessory Tray	$29
f4 Reducer lens (for 500mm telephoto)	$83

BAUSCH & LOMB
(INTERNATIONAL DEALERSHIPS AVAILABLE)
Binoculars • S. Scopes • Wholesale + BAUSCH & LOMB ACCESSORIES

PROFESSIONAL SERIES PL OCULARS 26mm...$49 16.3 ER....$49 / A.S. PLOSSL 7/12.mm...$39ea / 6mm OR...$45/ ZOOM ORTHO 8 to-21mm...$79 / 50mm RAM...$29 FILTERS SERIES 6 DROP-IN SET (6)..$49 WITH CASE / EYEPIECE ADAPTER..$49 / RFT ASSY ..$89 4X FINDER (4000)..$29/ MEASURING RETICLE EYEPIECE..$59/ PIGGYBACK MOUNT (4")...$21/ (6" & 8") ..$29/ BARLOW 2X...$49/ DYNA-TRACK AC/DC DRIVE CORRECTOR...$129./TRIPOD...6000/ 8000....$159 / 4000....$79/ MOTOR DRIVE (110 OR 220V)....$49/ f5 LENS......$89 / f 7.5Lens.....$89

6" MAKSUTOV $719
f10 - LATEST MK 65

DEW CAPS	10"	$49
	4"	$29

MISCELLANY LIST **Adlerblick 8X30**	**$148.**
Adlerblick 7x50 M/C	$295
20" f5 PARKS + ELLIPTICAL 5" (SPECIAL)	$2395
THOUSAND OAKS SOLAR FILTERS -ALL SIZES-	CALL
Glass-Full aperture 8 in. MOUNTED (C8-2080).	$79
Vogel - Digitrak Drives, Inverters-SPECIALS-	CALL
Battery Pack + Charger (12v) 5 AMP...$65. 12 AMP	$78
Polar Alignment Kit	$29

6000A B & L SCH/CASS
6" f10 $749
(12V DC MODE..$829)

IMPORT - EXPORT
A WORLD CLASS DISTRIBUTOR TO INDUSTRY - GOVERNMENT-PRIVATE AND PUBLIC EDUCATIONAL INSTITUTIONS.
RETAIL ACCOUNTS

4 1/2" REFLECTOR $219

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

NO APD PRODUCTS EXPORTED

★ ★ ★ OFFICIAL ★ MEADE ★ CELESTRON ★ B&L ★ AUTHORIZED DISTRIBUTORS

MEADE

NOTICE: COMPLETE MEADE PRICES LISTED IN JUNE ISSUE

TELESCOPES	
2045 Spotting Scope, 2045D	
90mm Alt.Z. W 1.25" Eyep. IN STOCK	**SPECIAL**
90mm Equit. W 1.25" EyeP IN STOCK	**SPECIAL**
2 4" (60mm) Alt. Refracting Telescope 1.25"	$124
2 4" (60m) Equatorial Refracting Telescope	$149
Refractors - LARGER SIZES	
4 1/2" Reflecting Telescope Heavy Duty Mount	$298
SN 8-8" f4 SCH/NEWT. f4.5 O.T Assy	$695
Newt. Reflectors 6", 8", 10", 16"	
REFRACTOR OPTICAL TUBE ASSY'S	
2080 f10 MC/OG WEDGE TRIPOD	$1099
COMPUTERIZED 2120 -10 in. f6.3	$2595
2060 16" f/10 SCH/CASS AVAILABLE NOW	
BINOCULARS	
[illegible]X80 M/X	ea $379
[illegible] M/C (BLKARMORED)	ea $359
ACCESSORIES	
Equatorial Wedge plus Tripod 2045 ★ Super Wedge 10"	
Equatorial Wedge for Model #2080, #2045, #2120 ★ Mounts	
Field Tripod for Model #2080, #2120	
Altazimuth Adp. for Field Tripod (#2080, # 2120)	$18
Deluxe Latitude Adjuster 2080 or 2120 ★ Magnetic Compass	
Azimuth Control (for Field Tripods for 2080)	
#603 DC Cord (25') w/cigarette plug	
Eyepiece Extender Tube only ★ Off-Axis Guider Body only	
Illum Ret Eyepiece Sys 1.25" 12mm, 9mm	
Spotting Scope Adp.Plate 2120, 2080	
EYEPIECES	
Mod. Ach. (965) 9 12 25 40mm	$34
Telecompressor System (f5) ★ F 6.3 Focal Red./Field Flattener	
Mod. Achromatic 1.25" 9,12,25,40mm	$29
Series 3000 Plossl 1 1/4" 5,6.7,9.5,16,25mm	$59
40mm PL 1 1/4"	$79
1.25" Orthos 4mm, 6mm, 9mm, 12.5mm M/C	$48
Sup Plossl 1 25" 6 4, 9 7, 12 4, 15. 20, 26mm	$79
32mm. 40mm, 1 25".....ea $98, 56mm, 2"	$213
13 8mm Super Wide 1 25"...$122 ★ 18mm 1 25"	$114
24. 5mm 1 25...$145 ★ 32mm 2"...$206, ★ 40mm 2"	$246
4.7mm 1 25"...$152 ★ 6.7mm 1 25"	$173
8. 8mm 1 25"/2 $212, 14mm 1 25"/2"	$248

Eyepiece Holder, 1 25" ★ #915 Diagonal Prism .965(90°), #917 Hybrid Diagonal Prism 965/1 25", #918 Diagonal Prism 1 25" ★ #929 2" Diag. Mirror inc. eyepiece adapter with 1 1/4" Adpt. ★ #930 Diag Mirror 2" OD Barrel for 2" Focuser Sleeve ★ #924 Erecting Prism 1 25" (Porro Type), #927 Erecting Prism 45° Diag. (.96), #928 Erecting Prism System 45° 1 1/4" ★ #912 Roof Prism 965, 90B, 97D, 97E, 97ER (STGT) ★ #931 Hybrid 45° Erecting Roof Prism .96 - 1 1/4"

FILTERS - WHY PAY MORE!
Photo Vis. Color Fil. & Pol. 1 25" All Col. Avail ★ Filter Sets 1 1/4" (4) #1, #2, #3, ★ Set of 6 Photo Visual Filters (965) Thread In ★ Series VI Drop-In Filter Set (2045, 2080) ★ Series V Set (90B, 97D, 97E, 97ER) ★ #905 Variable Polarizing Eyepiece System 1 25" ★ #908 Nebula Filter 1 25" (B) (N) ★ #910 2" (B) (N) ★ #911 (rear cell Thread on) (B) (N) ★ #122 2X Tele-negative Amplifier 1 1/4" ★ #126 1 1/4" Barlow (2045.4500) ★ #127 2X-3X Variable Tele-negative Amplifier ★ #131 2X Tele-negative Amplifier 965 ★ #140 2X Tele-neg Amplifier ★ Sun Shade (97) (2045) ★ Dew Shield 8" 2080, 2120 10" ★ #1A Skylight Filter/Dust Seal ★ #50A Acc'y Case (PROMO 50), ★ #50 Acc'y Case, (2045S) (97SS) (2045D) ★ #1401 Tube Balance Weight System 2080 ★ #1402 Tube Balance Weight System 2120 ★ Extra Counterweight 25lb, 1" OR 1 1/2" ★ #1206-1205 Elect. Focuser ★ #680-#682 Deluxe Focuser 1 25" & 2" ID ★ #60, #61, #62 T-Adapters ★ Tele-extender Tele-extender (Variable) ★ Basic Camera Adapter 1 25" 929" (.96) ★ Variable Projection Camera Adapter 1 25" ★ 2" Prime Focus Adapter (.96) ★ T-Mount Camera Ring Adp'rs (Spec. Camera & Model) ★ Piggyback Bracket 2080/2120, 2045 ★ #957 9x60 Finder Scope ★ #967 9x60 R/A Polar III ★ #637 6X30MM View Finder + Bkt. ★ #544, #545, 8x50 View Finder ★ Electric Motor Drive AC (323, 4420) + TASCO 4500 ★ #55 Manual Declination Cont., #65RS ★ 48RS Dual Axis Dr. Corrector Sys. ★ 65 RS DEC Control ★ #43 R A Drive Corrector ★ #46 Dual Axis Drive #47M DA Dr. Corrector Sys ★ 8000 OBJECT LIBRARY (2-5) CONTROL BOX LX5 ★ #39 Dec. Motor ★ 39S DEC MOTOR ★ #868 Extension Tube (for 2" eyepiece) ★ Vinyl Dust CAP for 16", 10", 6"...$26, pair 8" ...$28 ★ Accessory Shelf for 6"-8"-10"-16", Acc. Shelf for Field Tripod ★ Mirrors, Eq. Mounts - Please call for quotes

BAUSCH & LOMB

BINOCULARS ★ Elite (BK) Armored PC-3 Coated ★ 7x36, 8x42, 10x42 ★ Discoverer - [illegible] waterproof compacts ★ 7x24, 10x28 (BK) Armored C. F. Porro Prism ★ Astronomical-Terrestrial ★ 11x80 C.F., 20x80 C.F. ★ Custom ★ 8x36 Long Eye relief C.F./P.P. ★ 7x6 Long Eye relief C.F./P.P. ★ Legacy ★ 7x35 Extra WA (BK) Armored ★ 8x40 Extra WA (BK) Armored ★ 10x 50 Extra WA (BK) Armored ★ 7-15x35 Zoom (BK) Armored ★ 8x24 Compact Armored P.P. ★ 8x20 Roof Prism Armored ★ Auto Focus ★ 10x25 WA Glasses on ★ 7x35 WA (Blue Armored) ★ 10x50 WA (Blue Armored) ★ Nature View ★ 8x42 ★ Mini Compacts ★ 8x21 C.F., P.P.(BK) or (GRN) ★ Spectator Series-insta-focus ★ 7x35 WA Armored (GRY) ★ 8X40 WA Armored (GRY) ★ 10X50 WA Armored (GRY) ★ 7-15X35 Armored (GRY) ★ 7-15X40 Armored (GRY) ★ Spectator ★ Compact ★ 10x50 WA ★ 8x22 compacts (BLK) or (CAMO) ★ Powerview ★ 7x35 WA 8x30 (BK) armor ★ 10x50 WA (BK) or (CAMO) ★ 8x25 compact (BK) armor ★ 7-15x35 Zoom (BK) Armored ★ 8x21 Roof Prism (BK) Armored ★ 10x25 Roof Prism (BK Armored ★ 7-21x40 zoom (BK) Armored H Harbormaster Brass Telescope ★ Discoverer 15x60 x -60mm ★ 8080 Telephoto 800mm ★ Elite-Spotting Scopes ★ 77mm 77mm ED ★ 60mm, 15-45x60mm ★ Spacemaster Spotting Scope ★ 60mm, 60mm (CAMO) 15-45x Zoom ★ 60 MM ED (Prime Glass) ★ Eyepieces 15/20/22 WA/25/45/60/ 15-45 x Zoom ★ Banner Sentry - 50mm ★ Compact Competitor 40mm ★ Banner Stalker 50mm ★ Sportview Zoom 15 x 45/ 20-60x ★ Compact Spotting Scopes ★ Terrestrial Scopes ★ Roof Prism Armored Monocular 8x20 ★ Astronomical Scopes ★ Professional 560-560 x 4 1/2" ★ 454 x 60, 450 x 60, 345 x 60, 565 x 60 mm ★ Rotary Power 360, 500 ★ Compact 300x60, 455x60, 455x60 ★ Mercury 150 z 50, 208x50, 280x60 ★ Tripods Pro, Field, Table Top, Window Mt. ★ **ENSIGN** ★ 8x25, 10x25, 7x50, 8x40, 10x50, 7x25 ★ Water Prode ★ 7x50 (BK) or (YEL) ★ 8x36 ★ Concert-Opera ★ 3x23, 3x25, 3x28, 5x25 ★ Pearl, Gold, Blk ★ Economy ★ 7x35 Extended Eye Relief ★ 7x35 Fastview Focus Free ★ 7x35, 10x50 Falcon ★ Glass On ★ 7x35, 10x50, 8x40 Armored P.P. ★ 8x21, 7x35 WA Perma Focus ★ SE-R ★ 7x35 WA, 7x50, 10x50 ★ Perma Focus 2000 ★ 7x35, 7x35WA, 10x50 Wide Angle, 7x50, 7x21, 8x21 (bk) 8x21 (CAMO) 7x35 EWA, 10x50 EWA, 10x25 P.P. ★ 7x50, 7x42 Waterproof ★ Perma Focus 500 ★ 8x21, 10x25, 7x25, 7x35, 10x00WW ★ 10x50 WA ★ Mercury ★ 7x25, 7x50, 10x50WA, 7x35WA, 7x35, 8x21, 10x25 ★

CALL US LAST WITH YOUR LOWEST TELESCOPE-ACCESSORY PRICE QUOTE!

SWAROVSKI - COMPLETE LINE -

ALL MODELS............**CALL**...
COMPARE AND SAVE!
FUJINON

7X50 MTRC-SX..$372, 7X50 MTR-SX	**$320**
7X50 FMT-SX	**$397**
7X50 FMTR-SX	**$415**
10X70 FMT-SX..$474, 16X70 FMT-SX	**$528**
TRIPOD BKT.	**$14**

CCD'S CALL!

FILTER SPECIALISTS
H.R. SERIES -HIGH RESOLUTION
- PHOTO -VISUAL 1 1/4" FINEST AVAILABLE!
"WORLDS LARGEST SELECTION"

#1A	#8	#11	#12	#15
#21	#23	#25	#29	#47
#56	#58	#80	#82A	#85

#96ND - 50% #96ND - 25% 96ND - 13%
POLARIZER
$11 EACH
2"...$15 EA.
MADE IN U.S.A.
6 FILTERS ...... $59, 12 FOR $115
18 FOR.......... $162
EXCEPTIONAL FOR CCD

DOBS! CALL
6 INCH TO 16 INCH

WHOLESALE OPTICS DIVISION

• PUBLIC WELCOME • NO SALES TAX •
• SHOWROOMS: 57 NORTH STREET/SUITE 401, DANBURY, CT 06810 •
BUSINESS OFFICES SAT 11 to 5PM •
• PHONE ORDERS 10AM -10PM (7) DAYS A WEEK •

MAIL ORDERS TO:
29 KINGSWOOD ROAD
DANBURY, CT 06811
TEL: (203) 746-3579
FAX : (203) 746-7572 (24 HRS)
FAX ORDER LINE ONLY

Buyers Guide - CATALOGS

Telescope Accessory Catalog/Data Pack (2lbs)...$10 refundable
Catalog pkg. (Telescopes - Spotting Scopes - Accessories -Binoculars) (3lbs)...$15
Catalog Charge (Out of USA) .....$29 Minimum shipping Charge (via UPS)......$5
(CT Tax for in state sales only) Minimum shipping - Foreign Orders $29.00

JCB NOVUS 3% Credit Charge VISA

KOWA SPOTTING SCOPES

JIMS MOBILE
DEC MOTOR ..$73
MOTO FOCUS .$68
COMPLETE LINE
BEST PRICES
CALL!

TELRAD + BASE $39
WITH DEW SHIELD

EQUATORIAL MOUNT................$99
(FOR PHOTO TRIPOD)

★ ★ MOST ORDERS SHIPPED SAME DAY ORDERED ★ ★ ★ MINI TRACK QUARTZ DRIVE CORRECTOR...$79 ★ ★ ★ BUY DIRECT AND SAVE ★ ★

WE HAVE IT ALL ★ ★ ★ ★ (203) 746-3579 ★ TELEPHONE ORDER LINES 7 DAYS A WEEK ★ [illegible]

UNIVERSITY OPTICS ★ JASON ★ VOGEL/DIGITRACK ★ TIFFEN ★ DAVIS & SANFORD ★ J.M.I. ★ STEINER ★ ADLERBLICK ★ 1000 OAKS ★ SWIFT ★ EDMUND ★ NIKON ★ DELTA BRAND ★ EWA ★ TASCO ★ VIXEN ★ LOSMANDY ★ ZEISS

MEADE'S ONLY AUTHORIZED EAST COAST APD MAIL-ORDER DEALER

focus camera & video

FREE!
MILLER PLANISPHERE WITH EVERY SCOPE ORDER
While Supplies Last

FOR ORDERS ONLY CALL **800 221-0828**

INFORMATION HOTLINE **(718) 436-6262**

Meade Advanced Products

LX200 SCHMIDT-CASSEGRAINS 8"/10"/12" *CALL NOW!!!*

NEW TECHNICAL ADVANCES FOR 1994

- 18-volt Dual Axis Drive Systems:
  LX-200 motor torques are increased by about 60%
- Ultra Reliable Electronic Systems:
  The most trouble-free serious telescope ever manufactured
- New Version 3.20 Software:
  Quick (less than 10 seconds!) 2-star alignment
- Software Library Options:
  Library option 1 - 10,600 & library option 2 - 64,350
- PC-Interface Capability (w/Astro Search 200):
  Point and click on any of 45,000 planetary, deep space, or stellar objects
- Contrast Enhancing Fields Stops:
  Significantly increase lunar, planetary, and deep space image contrast

LX200 8"
$2295

LX200 10"
$2895

LX200 12"
$3995

LX200 16"
CALL

YOUR CHOICE F/6.3 OR F/10 SCT OPTICS

8" Wedge
$110

10"/12" Super Wedge
$396

Object Library #1
10,600 Celestial Objects
$99

Object Library #2
64,350 Celestial Objects
$149

AstroSearch/200
\$99^{95}

- Legendary Meade Super Multicoated (EMC) Optics:
  The finest SC optics available, optics that yield razor sharp stellar images & high resolution observing of the moon, planets, and deep space
- Heavy-Duty Fork Mounts:
  The largest, most rigid in the industry, complemented by large 4" diameter polar ball bearings & by DC servo motor-driven worm gears on both telescope axis
- Four-Speed Drives on Both Telescope Axis'
- Digital Readouts:
  On both axes, read from the keypad hand controller
- Goto Capability:
  Enter the RA & Dec of an object into the keypad hand controller, press GOTO and the telescope slews at up to 8°/second, centering it in the field
- 747 Built-in Object Library
- Permanently Programmable Smart Drive

STARFINDER EQUATORIAL

- Superb Optical System
- Precision Equatorial Mount
- Electronic Motor Drive

STARFINDER 6 6" F/8	$599.95
STARFINDER 8 8" F/6	$699.95
STARFINDER 10 10" F/4.5	$799.95
STARFINDER 16 16" F/4.5	CALL
4500 NEWTONIAN	CALL

STARFINDER ACCESSORIES

#47M Dual Axis Drive Corrector	*IN STOCK!*
Dust cover for Starfinder 6/8/10	**29.95**
#43 Drive Corrector	**88.50**
55 Dec	**79.95**

Pictor Series CCD IMAGERS

NEW **For the beginner, or for the most advanced observer, the *real* CCD revolution is here!** NEW

All models, including the least expensive unit, are simple to use. And yet, because state-of-the-art Meade electronic & software design, this simplicity is accomplished simultaneously with the most advanced CCD image resolution and performance in the history of amateur astronomy.

#201 Autoguider/Imager	$395
#208 Autoguider/Imager	$795
#216 Autoguider/Imager	$1195
#416 Autoguider/Imager	$2495
#1616 Autoguider/Imager	$6995
#616 Color Filter System	$695

NEW DOBSONIANS NEW

DOBSONIAN 6" F/8	$295
DOBSONIAN 8" F/6	$395
DOBSONIAN 10" F/4.5	$565
DOBSONIAN 12.5" F/4.5	$765
DOBSONIAN 16" F/4.5	CALL

- Primary & Secondary Mirrors of Low Expansion Pyrex Glass
- Precision Rack-and-Pinion Focuser

- Rigid, Durable, Beautiful Dobsonian Mountings
- Fully-Adjustable 4-Vane Secondary Mirror System

ED APOCHROMATIC REFRACTORS

American made ED Apochromatic refractors feature an f/9 doublet design

152ED 6 Inch F/9	**$4495**
127ED 5 Inch F/9	**$2795**
102ED 4 Inch F/9	**$2195**
178ED 7 Inch F/9	**$5495**
#1664 Elect. Drive	**369^{96}**
#1697 Computer Drive	**695^{95}**
285 60mm Equatorial Refractor	**309**
227 60mm Altazim. Refractor w/2 1¼" Oculars	**CALL**
390 90mm Altazim. Refractor	**CALL**
395 90mm Equatorial Refractor	**CALL**

SPOTTING SCOPES

MULTICOATED OPTICS LIFETIME WARRANTY

- 3½"1000mm F/11 optics
- 5x21 erecting image finder
- 45° erecting diagonal
- 40x Meade eyepiece

97E with Case	332.95
97ER Rubber Armored	359.95
2045S 4" SPOTTING SCOPE	**SPECIAL**
Carry Case for 97 E Series & 2045S	**49**

STANDARD SERIES SCHMIDT-CASSEGRAINS

2045D "The truly portable scope"	**CALL**
Case for 2045D	**75**
Trpd & Wedge	**234**
Piggyback Bracket for 2045D	**15.95**
2080A *"Perfect for the beginner"*	**$1099**
2080B with SMC multicoatings	**$1149**
2120A *"The best value 10" SCT"*	**$1399**
2120B with SMC multicoatings	**$1449**
LX100R 8" *NEW!*	**$1699**
LX100 10" *NEW!*	**CALL**
8" Wedge	**$110**
10" Wedge	**$250**
#1205 Controller	**CALL**

IN STOCK FOR SAME-DAY SHIPPING!

ACCESSORIES

EYEPIECES

SERIES 4000 SUPER PLÖSSLS

Meade Super PlÖssls are the finest general-purpose eyepieces available. All Multi-Coated

Super PlÖssls (SP; 4-elements: 1.25" 52°)

6.4, 9.7, 12.4, 15, 20, 26mm	**@ 86.95**
32mm, 40mm	**@ 107.95**
56mm (2")	**225.95**

SERIES 4000 SUPER WIDE ANGLE

Super Wide Angle (SWA; 6-elements: 1.25" 67°)

13.8mm	**155.95**
18mm	**165.95**
24.5mm	**195.95**
32mm (2")	**275.95**
40mm (2")	**335.95**

SERIES 4000 ULTRA WIDE ANGLE

The Ultimate Eyepieces; Extreme Image Sharpness Over an Amazing 84° Field.

Ultra Wide Angle (UWA; 8-elements: 1.25" 84°)

4.7mm	**177.95**
8.8mm (1.25"/2")	**265.95**
6.7mm	**216.95**
14mm (1.25"/2")	**326.95**

ILLUMINATED RETICLE EYEPIECES

SERIES 4000 PLÖSSL 9mm 1.25"

Without Cord	**129.95**
With Cord	**109.95**

MA 12mm 1.25"

Without Cord	**99.95**
With Cord	**79.95**

BARLOW LENSES & ACCESSORIES

#122 Doubles eyepiece power with sharp, high resolution, high contrast imaging on telescopes of all types. 27mm dia. Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths.
Multicoated 1.25" .... **CALL**

#126 Only 2.5 inches long, works well with any telescope excepting 1.25" eyepieces, even though with limited focus range.
Multicoated 1.25". .... **CALL**

#127 Precision internal sliding lens assembly permits continuously variable power settings between 2x & 3x. Engraved scale indicates power in use. Yields bright, sharp, high contrast images, on telescopes of all types.
Multicoated 1.25" .... **CALL**

#140 2x Apochromatic
The most advanced barlow lens available for commercial telescopes; includes 3-element, air spaced optics, multicoated. .... **CALL**

Camera Adapter .965"	**27.95**
1.25"	**27.95**
Variable Projection Camera Adapter 1.25"	**39.95**
Basic Tele-Extender	**29.95**
Variable Tele-Extender	**39.95**
T-Adapter for SCT's	**26.95**
#927 45° Erect Image Diagonal Prism .965"	**49.95**
#928 45° Erect Image Diagonal Prism 1.25"	**49.95**
#929 2" Diagonal Mirror	**99.95**
#931 Hybrid: Excepts 1.25" eyepieces, Fits .965" Focusers	**49**

FILTERS

Series 4000 Nebular Filters 1.25"

Premium multilayer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high contrast observing of faint nebulae.

Broadband Filters

#908B	**79.95**
#910B	**119.95**
#911B	**99.95**

Narrowband Filters

#908N	**89.95**
#910N	**129.95**
#911N	**119.95**

Series 4000 Photo-Visual Color Filters 1.25"

Made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Fully coated

#8 Lt. Yellow; #11 Yellow-Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue	**@ 21.95**
Moon Filter #ND96 Reduces brightness by 87%	**15.95**
Set #1 4-Filters: #12, #23A, #58, #80A	**49.95**
Set #2 4-Filters: #11, #25A, #47, #82A	**49.95**
Set #3 4-Filters: #8, #21, #38A, #56	**49.95**

TOP EAST COAST DEALER! **CELESTRON** **WE WILL MEET & BEAT ANY LEGITIMATE PRICE!**

GP-C8

- Well engineered and technically advanced German equatorial mount
- Adjustable wood tripod with excellent vibration dampening characteristics
- Precision 144-tooth lapped worm gears in both axes
- Built-in illuminated polar alignment scope for easy setup and operation - usable in both Northern & Southern Hemispheres
- Adjustable counterweights make it easy to point, balance and use
- Setting circles on both axes

$999

Great Polaris C8 with Starbright *NEW!* **1199**

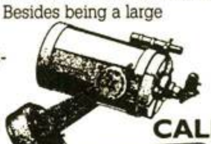
ULTIMA 8 PEC

The Ultima 8 PEC was completely redesigned to provide unsurpassed optical excellence, with superior mechanical and structural stability. A rugged highly damped mount makes viewing and astrophotography a delight. Ergonomic user-friendly operation is the trademark of the Ultima 8 PEC.

SPECIAL!

GG-11 .... ***IN STOCK!***

CLASSIC 8



The Classic 8 is an 8" diameter, 2032mm focal length, f/10 Schmidt-Cassegrain. Besides being a large aperture astronomical telescope, the 8" Schmidt-Cassegrain makes an excellent terrestrial instrument for observing close-ups of birds, plants and people, or taking in distant vistas.

CALL

ULTIMA 2000 8" & 11"
- NO ERROR TELESCOPE
- BUILT IN OPTICAL ENCODERS
- THE ULTIMATE IN SIMPLICITY & USER FRIENDLINESS

NEW **CALL** **NEW**

C5/C5+

For astronomy on the go, the C5 can't be beat. Extremely portable, fits virtually anywhere from a compact car trunk to most airline overhead compartments. A serious, high quality precision instrument. The C5 was chosen by NASA for several recent shuttle missions.

SPECIAL!

C8+/C8+ Computerized .... ***CALL***

NEWTONIANS

NEW! GP-C200 f/4 7.9" Reflector	***IN STOCK!***
C4.5 4-1/2" (114mm) aperture telescope	**459.95**
NEW! Firstscope 114 (4½") Reflector	**CALL**

REFRACTORS

GP-C102	**CALL**	GP-C102F	**CALL**
Firstscope 80 78% Brighter than 60mm scopes	**CALL**		
Firstscope 60 *NEW!*	**128.95**		

ACCESSORIES

Barlow Lens 2x 1.25"	**62.95**		
Counter Weight Bar Assembly 8"	**59.95**	11"	**64.95**
DEC Motor f/#93516	**129**	DEC Motor f/Classic 8	**89**
DEC Motor f/C5+	**99.95**	DEC Motor f/C8+	**124.95**
DEC Motor f/PEC's	**129.95**	Diag. Mirror Star 2"	**179.95**
Diagonal Star 1.25" w/Multicoatings	**44.95**		
Digital Setting Circles - Advanced Astro Master	**CALL**		
Drive Corrector Heavy Duty	**394.95**		
Expanding Bushing .96" to 1.25"	**49.95**		
Finderscope 7x50	**159.95**	Focusmotor f/PEC's	**139.95**
MFFT-55	**134.95**	Micro Guide Eyepiece	**159**
Motor Drive f/C4.5	**174.95**	Motor Drive f/GP/SP	**269**
Multiple Holder 1.25"	**145**	Visual Back 1.25"	**52.95**
Photo Tripod Adptr	**CALL**	Piggyback Mount 8"	**34.95**
Piggyback Bar Assembly 11"	**64.95**		
Polar Axis Finder	**89.95**	Radial Guider	**114.95**
Radial Guider f/C5	**119.95**	Reducer Corr. f/6.3	**119.95**
Reducing Bushing	**49.95**	Shoulder Mount	**79.95**
Tripod 8"	**259.95**	Tripod, Mini	**34.95**
Vibration Suppression Pads	**49.95**		

EYEPIECES

PLÖSSL 1-1/4"

7.5mm	**CALL**	10mm	**CALL**	17mm	**CALL**
26mm	**CALL**	40mm	**CALL**		

ULTIMA SERIES

5mm 1¼"	**CALL**	7.5mm 1¼"	**CALL**	12.5mm 1¼"	**Call**
18mm 1¼"	**CALL**	24mm 1¼"	**CALL**	30mm 1¼"	**CALL**
35mm 1¼"	**CALL**	42mm 1¼	**CALL**	60mm 2"	**CALL**

FILTERS

Eyepiece Filters 1-1/4" - #1A, #8, #12, #15, #21, #23A, #25, #38A, #47, #56, #58, #80A, #82A, #96ND-50%T, #96ND-25%T, #96ND-13%T, Polarizing .. **CALL**

PRECISION SOLAR FILTERS MOUNTED
by Thousand Oaks Optical

2.4"	**61.90**	3.1"	**64.90**	4¼"/5"	**95.90**	6"	**104.90**
8"	**124.90**	10"	**138.90**	11"	**148.90**	12.5"/13.1"	**179**

GENESIS-SDF KIT
Sky Tour Observing System

Featuring: *21mm Plossl* 4" aperture, 540mm fl, f5.4, 4 element APO Special Dispersion + Fluorite, Ash Wood Tripod, Gibraltar Mount, Air-Chair, Starbeam & *NEW* Sky Tour Computer with Encoder Kit ***PLUS FREE! 7mm Nagler & 1.8x Barlow.***

PRONTO
70mm, E.D. Doublet, 480mm, f/6.8

Pronto w/2" Star Diag. 70mm f6.8 ED Glass & 21mm Plossl	**CALL**
Pronto with Amici Prism & 21mm Plossl	**CALL**

Tele Vue®
"Tops in the Field"

NOW... BY POPULAR DEMAND!

EYEPIECES

NEW PANOPTIC *Tack Sharp*

15mm 1¼"	**CALL**	22mm 1¼"/2"	**CALL**
27mm 2"	**CALL**	35mm 2"	**CALL**

NAGLER *Spacewalk Experience*

12mm Type 2 1¼"/2"	**CALL**		
16mm Type 2 1¼"/2"	**CALL**		
20mm Type 2 2"	**CALL**		
4.8mm 1¼"	**CALL**	7mm 1¼"	**CALL**
9mm 1¼/2"	**CALL**	13mm 1¼"/2"	**CALL**

PLOSSL

7.4mm 1¼"	**CALL**	10.5mm 1¼"	**CALL**
13mm 1¼"	**CALL**	17mm 1¼"	**CALL**
21mm 1¼"	**CALL**	26mm 1¼"	**CALL**
32mm 1¼"	**CALL**	40mm 1¼"	**CALL**
55mm 2"	**CALL**		

WIDEFIELD

15mm 1¼"	**CALL**	19mm 1¼"	**CALL**
24mm 1¼"	**CALL**	32mm 2"	**CALL**

BINOCULARS

CELESTRON

HOW TO CHOOSE BINOCULARS	**6.95**		
7x42 Ultima	**189**	7x50 Ultima	**249**
8x32 Ultima	**185**	8x56 Ultima	**279**
10x42 WA Ultima	**225**	10x50 Ultima	**259**
11x80 MC.	**299**	15x80 MC	**319**
20x80 MC.	**329**	9X63 Pro	**205**

CELESTRON SPOTTING SCOPES

C90 All Models Including 1.25", **C5** 5", **500/5.6, C8** .... **CALL**

SWAROVSKI OPTIK

SPOTTING SCOPES

AT-80	**CALL**	ST-80	**CALL**
AT-80 HD (Angled)	**CALL**		
ST-80 HD (Straight)	**CALL**		
CT-75	**CALL**	CT-85	**CALL**

EYEPIECES

ATO-20-60x	**CALL**
ATO-15x & 22x	**CALL**
ATO-33WWX	**CALL**

SLC SERIES

NEW! B7x30B MKIII	**CALL**
NEW! B8x30 WB MKIII	**CALL**
B7x42 WB Blk, Grn	**CALL**
B8x30W MKII Grn	**CALL**
B10x42 WB Blk, Grn	**CALL**

FUJINON

6x30 FMTR-SX Rubber Armored	**341.95**
7x50 FMT-SX w/carry case	**372.95**
7x50 FMTR-SX Rubber Armored	**415.95**
7x50 FMTRC-SX Armored w/compass	**472.95**
8x30 FMTR-SX Rubber Armored	**339.95**
10x70 FMT-SX w/carry case	**470.95**
16x70 FMT-SX w/carry case	**520.95**

Nikon® ***SPORT OPTICS***
You'll never see things quite the same again.®

STAYFOCUS PLUS SERIES

7x35 RC	**89**	7x50 RC	**109.95**	10x50 RC	**110**

CRITERION SERIES

7x35 E	**259**	8x30 E	**279**	10x35 E	**319**
10x70 IF	**699**	10x70 HP IF	**899**		
10x50 Lookout	**109.95**				
7x50 IF SP Prostar WP	**689.95**				

SPOTTING SCOPES

Fieldscope ED II Body W	**497.95**
Fieldscope ED II Angled Body W	**549.95**
Fieldscope ED II 78mm	**919.95**
Fieldscope ED II 78mm Angled	**979.95**

BUSHNELL
Division of Bausch & Lomb

Spacemaster	**138.95**
Spacemaster Kit w/15-45 Zoom Eyepiece	**238.95**
Spacemaster ED Glass	**293.95**
Armored Spacemaster	**157.95**
Armored Spacemaster Kit w/15-45 Zm Eyepiece	**254**
Discoverer	**172.95**

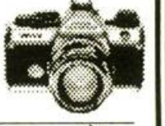
MANUAL CAMERAS

Nikon FM-2

- You are in Command
- 3-Point LED Exp. Display
- Legendary Nikon Performance & Durability

$429

OLYMPUS OM-4T



CALL

- Manual aperture & shutter control
- Titanium housings for increased ruggedness, decreased weight

PENTAX K1000

- Full Manual control
- ISO 20 to 3200 film speed range

$174.95

Nikon N6000 Body	**359.95**	F-3HP Body	**CALL**
Canon F-1 Body	**CALL**	Contax S2 Body	**CALL**
Leica R6.2 Body	**CALL**	Pentax LX Body	**CALL**

beattie INTENSCREENS **CALL**
- Increased Brightness • Easier to Focus

FILM

KONICA		KODAK	
SRG 3200 24 Exp	**6.25**	TMZ 3200 36 Exp	**4.50**
SRG 3200 36 Exp	**7.59**	Royal Gold RF 1000 24Exp	**5.73**
SR 100 36 Exp	**2.69**	Royal Gold RF 1000 36Exp	**7.29**

Focus camera, inc.
4419-21 13th Ave., Brooklyn, NY 11219

THESE ADVERTISED PRICES ARE VALID **SEP. 1 - SEP. 30, 1994** SUBJECT TO PRODUCT AVAILABILITY
ORDERS ONLY CALL **800 221-0828** INFORMATION & NY STATE CALL (718) 436-6262
ORDER STATUS & CUSTOMER SERVICE **(718) 871-7608** 24 HOUR FAX LINE **(718) 871-1152**

Orders Shipped Promptly - Most Major Credit Cards, Money-Orders & Personal Checks accepted for payment. COD orders are accepted but may require a deposit, personal checks may require up to 14 days to clear. All orders are subject to verification & acceptance. Shipping handling & insurance are additional, please call/write for exact details. 14-day money back guarantee (less shipping) provided merchandise is returned in new condition, unused as received with papers & packaging intact. **We gladly accept and reply to written or faxed inquiries.** Not responsible for typographical errors. These ad prices are only available while supplies last. This ad supersedes all previous ads. Hours: Mon-Thurs.. 9-7, Fri 9-2, Sun 10-6.

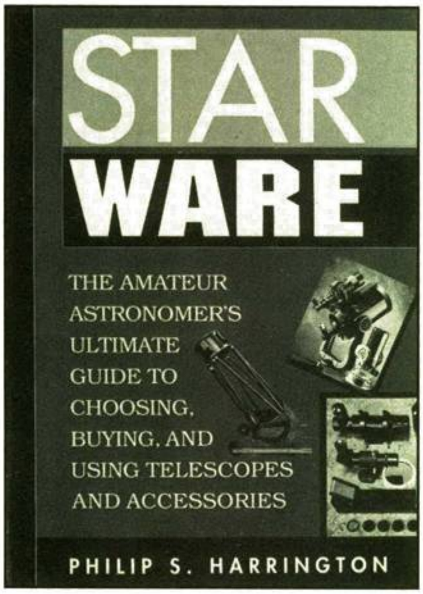
ASTRONOMY BOOKS

Treading the Telescope Minefield

Star Ware

Philip S. Harrington, (John Wiley & Sons, 1994), ISBN 0-471-57671-9, 373 pages, softcover, $19.95.

Call it a rite of passage. Call it the first step on an exciting journey. Call it what you want, but buying a first telescope is a leap of faith. For the beginning astronomer it is a gamble — a hunch concerning the nature of a hobby not completely known. Does spending more really guarantee a better telescope? For that matter, does "cheap" have to mean poor quality? The telescope market is huge and has many choices, and a road map would certainly come in handy. Philip Harrington's book *Star Ware* gives the first-time telescope purchaser a means to scope out a buying strategy, wisely and with the least amount of pain.



STAR WARE

THE AMATEUR ASTRONOMER'S ULTIMATE GUIDE TO CHOOSING, BUYING, AND USING TELESCOPES AND ACCESSORIES

PHILIP S. HARRINGTON

ASTRONOMY: Jim Forbes

The book opens with telescope talk, explaining terms like aperture and focal ratio and then lays out the difference between magnification, light-gathering power, and resolving power. What is the telescope's history and how have types evolved over time? Read on to the section explaining Newtonian reflectors as as well as refractors and catadioptrics. And no discussion of telescope types would be complete without taking into account altazimuth and equatorial mounts. Finally, Harrington introduces a "point-counterpoint" forum in which he compares various telescope designs. There's even a self-conducted survey to ascertain which kind of scope may be right for the reader.

Following that thorough briefing, it's time to move into a market survey. Chapter four is a compendium of who makes what kinds of scopes and how much they sell for. Harrington also gives advice on how to purchase used telescopes. Because transactions sometimes don't go smoothly, especially when conducting business by phone and mail, he gives timely information on buyer's rights and how to handle situations in which a merchandise return is involved.

After telescopes and mounts it's the doodads, as in eyepieces, finders, filters, camera and computerized aids, that fall under Harrington's eye. He describes eyepiece designs, telling the reader what types work best with certain telescopes for certain observing demands. Chapter six, "The Right Stuff," gets into everything else, from collimation tools to binocular viewers that attach to scopes.

And that's just the first half of the book.

The last half of *Star Ware* presents the "nuts and bolts" aspects of amateur astronomy. Harrington offers ten do-it-yourself projects that include an illuminated clipboard, a portable observatory, and an observing chair. Each project write-up has a parts list and assembly diagram. This section on tinkering leads to a chapter on how to keep telescope optics clean and aligned. Finally, Harrington takes to the sky.

Chapter nine imparts "tricks of the trade," such as how to select an observing site and evaluate atmospheric seeing. After the preliminaries, it is time, as the author puts it, to fly solo. Chapter ten outlines lunar, planetary, and deep-sky targets to get acquainted with, even getting into the basics of astrophotography.

Star Ware does what it promises: It serves as a guide to choosing, buying, and using telescopes and accessories. Perhaps the table of contents could have been broken down into subheadings, making it easier to access certain topics. But this is a minor criticism; the main body of the book is chock-full of info beginners are looking for. The writing is lively, the information timely, the logic clear, and the tables and illustrations useful.

Is this book just for beginners looking to make a leap of faith? Hardly. Anyone looking for a survey of what's on the market, how it works, and what it's used for should consider adding *Star Ware* to the bookshelf. — *John Shibley*

Other New Books

Your Guide to the Sky

Rick Shaffer (Lowell House, 1994), ISBN 1-56565-047-6, 186 pages, softcover, $14.95.

ASTRONOMY columnist Rick Shaffer has penned a lively guide to what's in the night sky and how to see it. The book is laid out in sections that progress outward from Earth, with each concisely covered in as little space as possible. This brevity lends itself to browsing and allows the reader to pick up important facts in one sitting. Shaffer also includes information on how to use a telescope and discusses observing techniques. Monthly sky maps and tours of deep-sky objects round out the book. For a survey on casual observational astronomy, Shaffer's guide is worth considering.

The 20-cm Schmidt-Cassegrain Telescope

Peter Manly, (Cambridge University Press, 1994), ISBN 0-521-43360-6, 283 pages, hardcover, $29.95.

Eight-inch (20-cm) Schmidt-Cassegrain telescopes are ubiquitous in amateur astronomy. Their popularity stems from their compactness and wide selection of accessories. It makes sense, then, that a book should appear on the market *tailored* to the venerable 8-inch's capabilities. Manly walks the reader through all sorts of observing projects, gives tips on photography, and presents a survey of accessories useful for both types of activities. Appendices tell the reader how to polar align, collimate, and clean the telescope. Unfortunately, he gives only brief mention to CCD photography. But that aside, this book does an exceptional job in conveying the 8-inch SCT's exciting potential. People who own, or are planning to buy, this type of scope will want to examine this book.

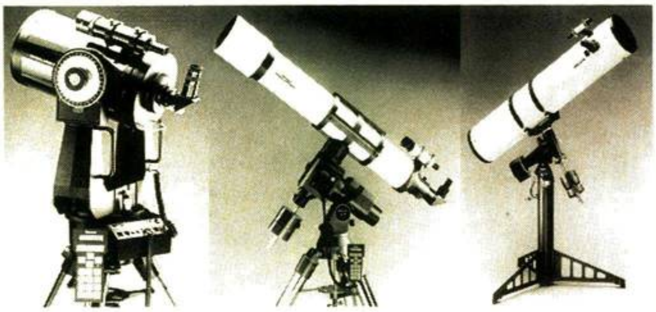
The Friendly Guide to the Universe

Nancy Hathaway, (Viking, 1994), ISBN 0-670-83944-2, 377 pages, softcover, $21.95.

Friendly Guide offers a chronological history of the universe, moving from Earth out to the galaxies beyond. Hathaway treats the reader to interesting trivia and fascinating anecdotes from humankind's discovery of the cosmos. She also profiles many of astronomy's notables through biographical sketches. Thrown in for good measure are explanations of astronomical phenomena. Hathaway also explores this science's impact on the arts and presence in mythology. *Friendly Guide* is for readers who want to know the story behind astronomy's evolution, from astrology to the current ideas about the Big Bang. □

Meade

ADVANCED PRODUCTS



For Pricing, Call:

818-505-8424

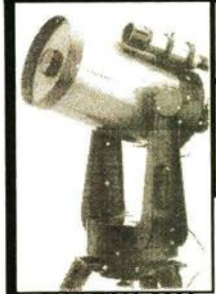
California Telescope Company

P.O. Box 1338, Burbank, California 91507
MasterCard, VISA, DiscoverCard

ASTRONOMICAL ENTERPRISE

Mon-Sat 10am-6pm • 5920 Roswell Rd. A206, Atlanta, GA 30328
Orders: 800-717-AEAE • Info: 404-843-3838 • Fax: 404-843-8545

FREE CATALOG! *SIZZLIN SUMMER SALE*



8" ULTIMA 2000

←*NEW SCOPE*

CALL for current specials on clearance items!

We have package deals on many popular scopes—CALL for details!

CELESTRON

Celestron's new U200 scopes are incredibly easy to use!

ULTIMA 2000 8" SCT	$2495
ULTIMA 2000 11" SCT	$3595
C8+ telescope, wedge	$1249
C8+ Computerized	$1699
C5+ Compact SCT	$1149

Packing, Shipping charges not included.

11x80 Giant Binoculars	$359

INTES

MK65 6"f/10 OTA	$895

JMI

We stock JMI MAX Computer systems, NGF focusers, Motofocus, Motodec units.

LUMICON

Lumicon Nebula Filters and Off-Axis Guiders are the finest. 2.5x Telecompressor lens for ST-6 CCD camera $98

MEADE

We are a FULL LINE MEADE DEALER. CALL for pricing and product information!

SWIFT

11X80 Observer Binocs	$339
7x50 Sea Wolf (waterproof, FOGPROOF!) Binocs	$175

TELE VUE

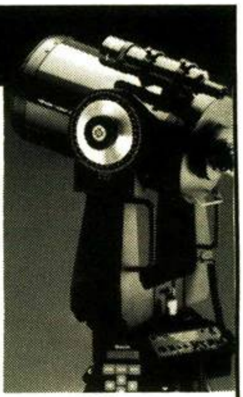
Genesis-SDF ED APO	$1895
Gibraltar Mount	$469
Plössl eyepieces low as	$77!

New PANOPTICS really are much sharper than other wide field oculars. CALL!

C.O.D.'S welcome. No Charge for VISA, MC!

Anyone can sell you a telescope.

We'll sell you the right one.



Hardly a day goes by that we don't get a letter like the one below, or a call that goes something like this: "Your ads are right. So and so on the East Coast advertises low prices – but they don't have what I want in stock, they couldn't answer *any* of my questions, and they wanted my credit card number before they'd even *talk* to me. They said if I wanted specifications, I should call the manufacturer . . . and then they hung up on me!"

It takes more than a camera store clerk with a price list and a bad attitude to help you pick the right telescope. It takes experience. It takes people who actually use the telescopes and accessories they sell. At ***astronomics***, we have that experience. We've been selling telescopes for 16 years. We've been using them far longer than that. From $329 to $16,000, we'll help you pick the telescope and accessories that fit your needs . . . *and your budget.* Meade, Celestron, TeleVue, Edmund, Questar, and more – we have *all* the good stuff.

astronomics. No hard sell. No guesswork. Just honest advice, the *right* telescope . . . and a good price.

Call us at (405) 364-4898 and find out for yourself. Our years of experience are yours for free.

We have Meade Advanced Products – scopes and accessories – *in stock!*

Whether it's a complete Meade telescope, like the fully-computerized LX200 shown above, or a simple Meade accessory like an eyepiece, a filter, a Barlow, or a camera adapter – if Meade makes it, chances are good we have it in stock. Since Meade prices are usually the same anywhere you go (although one of our customers said another dealer advertised a Meade scope for $2895, but charged his credit card $3300 for it – without ever shipping the scope), there's no sense in buying from a dealer who takes your money and makes you wait and wait – not when you can get it *now* . . . from ***astronomics.***

Want to pick the right telescope? Our free catalog tells you how!

Call us at (405) 364-0858 for your *free* copy of our catalog 94AST that has details on the hundreds of telescopes and accessories we stock – from Celestron, DayStar, Edmund, Meade, Questar, TeleVue, Lumicon, JMI, SBIG, and more. We'll also include our 8-page guide on how to pick the right telescope, your discount prices on everything we carry, and some unadvertised special sale prices. It's all yours for only the cost of a one minute telephone call. It will be the most informative one minute call you'll ever invest in astronomy.

Customer Quote of the Month #31

Thanks for the Services, outstanding As Always

astronomics

Our 16th year of friendly service, good advice, and money-saving prices.

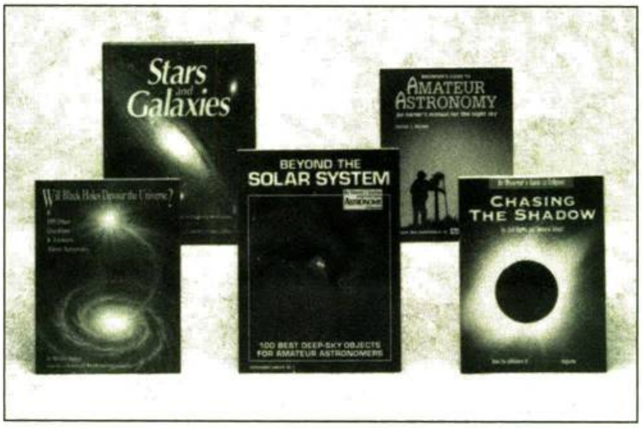
2401 Tee Circle, Suites 105/106, Norman, OK 73069

Order Line: **(800) 422-7876** 24-hour Fax: **(405) 447-3337** Catalogs/Advice: **(405) 364-0858**

Hours: Monday thru Friday, 10:00 AM to 5:00 PM CST U.S. SALES ONLY Mastercard, Visa, Discover, American Express $5 minimum freight

LIBRARY OF ASTRONOMY®

Explore the Heavens with Books from ASTRONOMY®



Stars and Galaxies
Amateur Astronomy
Beyond the Solar System
100 Best Deep-Sky Objects for Amateur Astronomers
Will Black Holes Devour the Universe?
Chasing the Shadow

Will Black Holes Devour the Universe? & 100 Other Questions & Answers About Astronomy

NEW!

Why do stars twinkle? Will the sun ever burn out? Astronomy's most-asked questions are answered in this charming book that satisfies the curiosity within us all. Clear, concise explanations address complex topics with the aid of helpful illustrations. By Melanie Melton. 7¼ x 9¾, 104 pgs., 11 illus., sftbd.
#18541 .... **$14.95**

How to Build Your Own Observatory, Third Edition

Learn how to make everything from a simple wind shelter to a classic white dome to house your telescope. Includes numerous photos and diagrams with construction techniques and ideas for 17 different backyard observatories. From *Telescope Making* magazine. 8½ x 10½, 97 pgs., 164 b&w photos, 25 illus., sftbd.
#18004 .... **$14.95**

Stars and Galaxies: ASTRONOMY's Guide to Exploring the Cosmos

Thirty-six deep-sky articles from ASTRONOMY magazine explain general deep-sky observing, galaxies, stars, clusters, and bright and dark nebulae. Edited by David J. Eicher. 8½ x 11, 192 pgs., 129 b&w and 110 color photos, 98 illus., 34 charts, hrdbd.
#18536 .... **$29.95**

The Light-Hearted Astronomer

Whether you're a starting stargazer or an advanced astronomer, the author's humorous look at his first attempts at astronomy offers encouragement and fun. An unintimidating introduction to an often challenging hobby. By Ken Fulton. 5½ x 8½, 115 pgs., sftbd.
#18001 .... **$9.95**

The New Cosmos: The Astronomy of Our Galaxy and Beyond

A cutting-edge glimpse of our changing view of the universe. Black holes, radio galaxies, quasars, the Milky Way, high-tech telescopes—explore these and other topics through spectacular color photographs, compelling text and award-winning illustrations. From ASTRONOMY magazine. 8¼ x 10¾, 160 pgs., 132 color and 6 b&w illus., sftbd.
#18537 .... **$19.95**

The Moon: An Observing Guide for Backyard Telescopes

Embark on a telescopic voyage of exploration to our closest celestial neighbor. Descend into terraced craters, soar over lofty mountains, and trace twisting lunar rilles. A guidebook packed with facts and pictures. From the publishers of ASTRONOMY magazine. By Michael T. Kitt. 8½ x 11, 80 pgs., 50 b&w photos, sftbd. #18534 .... **$11.95**

Beyond the Solar System: 100 Best Deep-Sky Objects for Amateur Astronomers

An organized tour of the best deep-sky objects viewed through binoculars or a backyard telescope. Spiral galaxies, glowing gas clouds, binary stars, newborn blue-white suns, and other objects are shown with information about their discovery, evolution, location, and characteristics. From the publishers of ASTRONOMY magazine. By David J. Eicher. 8½ x 11, 80 pgs., over 100 b&w and 25 color photos, sftbd.
#18535 .... **$12.95**

Atlas of the Moon

Find your way around the moon with 76 large-scale maps that beautifully portray the entire lunar face visible from Earth. Every feature is plotted and identified. Explains the moon's origin and history, with superbly detailed lunar photos. By Antonin Rukl. 8¾ x 11¾, 224 pgs., 70+ b&w photos, 190+ diagrams, hrdbd. (Available to U.S. customers only.)
#18539 .... **$29.95**

The Universe from Your Backyard

Tour 46 constellations featuring 690 of the finest deep-sky objects. Includes charts, telescopic sketches, and three-color sky maps. By David J. Eicher. 8½ x 11, 188 pgs., 50 b&w and 90 color photos, hrdbd.
#18037 .... **$29.95**

Beginner's Guide to Amateur Astronomy

Identifies the best objects visible with the naked eye, binoculars, and a small telescope. Discusses telescopes and how to choose one, astrophotography, CCD-camera imaging, and the latest astronomy findings. Includes many useful appendices. By David J. Eicher. 7⅜ x 9⅛, 176 pgs., 80 color and 80 b&w photos, sftbd.
#18540 .... **$19.95**

Chasing the Shadow: An Observer's Guide to Eclipses

The most complete guide to solar eclipses available, focusing on the nine central eclipses of the 1990s. Practical, detailed information on travel preparations, observation sites and techniques, equipment, photography, safety, and benefits of studying the eclipsed sun. By Joel Harris and Richard Talcott. 7⅜ x 9⅛, 160 pgs., 48 photos, 14 maps, sftbd.
#18542 .... **$18.95**

Color Star Atlas

The colors of all naked-eye stars are clearly shown in this easy-to-use atlas. Twenty wide-angle charts locate all stars down to a magnitude of +6.55, along with galaxies, nebulae, clusters, and other deep-sky objects. By John Cox and Richard Monkhouse. 11⅛ x 15¼, 40 pgs., sftbd. (Available to U.S. customers only.)
#18038 .... **$19.95**

Galaxies and the Universe: An Observing Guide from Deep Sky Magazine

The most up-to-date source for exploring galactic domains with a backyard telescope. Contains practical tips, how-to information, maps, and hundreds of photos and diagrams for observers at all skill levels. Compiled by the nation's leading deep-sky observers. 8¼ x 10¾, 112 pgs., 22 color and 131 b&w illus., sftbd.
#18538 .... **$14.95**

To order call toll free, 24 hours a day

1-800-533-6644.

For faster service call Monday – Friday 8:30 am – 5:00 pm CT.

Please have your credit card ready.

Fax 414-796-0126.

Outside the U.S. and Canada call 414-796-8776.

Use this coupon and mail to: Kalmbach Publishing Co., Dept. AC104, 21027 Crossroads Circle, P.O. Box 986, Waukesha, WI 53187-0986. **Include for postage and handling:** U.S. add $3.00 4th class (or $4.50 UPS continental U.S. only); Canada add $5.00, other foreign add $10.00. Maryland and Wisconsin residents add 5% sales tax to total. Canadian orders add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change. **On a separate sheet list each product title and item number you are ordering. *Enter total amount on this form.**

Name ____________________

Address ____________________

City ____________________

State, Zip ____________________

* Total Enclosed $ __________ **(Please include postage and taxes.)**

Credit Card # ____________________

We accept: American Express (min. $15), MasterCard and VISA.

Expiration Date ____________________

Phone ____________________

Fax ____________________

Signature ____________________

Dept. AC104

MEETINGS & EVENTS

September 30–October 1
Hidden Hollow Convention, Mansfield, OH. Contact Hidden Hollow Convention Coordinator, P.O. Box 1118, Mansfield, OH 44901-9998.

October 1
10th Annual Blue Ridge Parkway Regional Stargaze II, near Blowing Rock, North Carolina. Contact Greg Kirby, 5026 Poplar View Lane, Granite Falls, NC 28630, (704) 396-7656.

October 1
Fall Star Party, Tidewater Community College, Virginia. Contact R. H. Stewart, 1064 Dune Street, Norfolk, VA 23503, (804) 583-9397.

October 1-2
1994 NEKKAL Annual Awards, Eskridge, Kansas. Contact Brenda Culbertson, 681 Frog Hollow, Harveyville, KS 66431, (913) 589-2405.

October 1-2
Nightfall, Borrego Springs, California. Contact Nightfall, c/o Fox & Stephens, 9045 Haven Avenue, Suite 109, Rancho Cucamonga, CA 91730, (909) 948-2205.

October 4-9
11th Annual Okie-Tex Star Party, Lake Murray State Park, Oklahoma. Contact Beryl Cadle, 6616 N.W. 20th Street, Bethany, OK 73008.

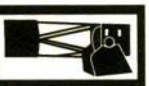
October 7-8
11th Annual Bays Mountain StarFest, Kingsport, Tennessee. Contact StarFest Coordinator, Bays Mountain Park and Planetarium, 853 Bays Mountain Road, Kingsport, TN 37660, (615) 229-9447

October 7-9
Stella-Della-Valley VIII, Ottsville, Pennsylvania. Contact Ed Melnick, 1443 Devon Road, Warminster, PA 18974, (215) 443-7929.

October 14-16
10th Annual Midwest Space Development Conference, Cleveland, Ohio. Contact MSDC, 524 West 6th Street, Lakeside, OH 43440-1717. ☐

Please submit events at least four months in advance to ASTRONOMY, Tracy Staedter, P.O. Box 1612, Waukesha, WI 53187-1612.

NEW!
DOB DRIVER II



Dual axis microstep quartz drive fits all Dobsonians, or user-built equatorials. Powerful computerized tracking, panning, and guiding in the palm of your hand! Super portable, super simple. AC/DC/CAR/BAT 12v. Instant setup - NO ALIGNMENT! Multi-function display. Calibration supertunes your scope to maximum performance. Options for PC link/CCD link/field-rot/DSC.

ALL TRACKERS INCLUDE SECTOR-SEARCH MODE...
Control only - $299 ATM System - $399
Complete system w/ready-to-install drives - $499
Free lit - satisfaction guaranteed!

TECH2000 3349 SR99 S
Monroeville, OH 44847
Ph. 419-465-2997 • VISA/MC • WORLDWIDE DEALERS
Pocono Mtn. Optics/PA • Broadhurst-Clarkson-Fuller/UK
Kokusai Kohki/JAP • Ultra-Vue Optics/AUS

NOTICE

Please be advised that any person or company making claims that they were once affiliated with the world's largest solar filter manufacturer, Thousand Oaks Optical, and that their filters offer an identical view, is not true. The person making these claims was employed as a part-time assembler for Thousand Oaks Optical. We hereby disavow any responsibility for the **safety** and quality of their product, nor should it be construed that it's the same as ours. For the past fifteen years the product safety and reputation of glass solar filters has been achieved by the owner of Thousand Oaks Optical.

Earn $4,000 Per Month From Your Home With A Computer!

FREE CBSI 486 *Computer*

Begin part-time and still retain the security of your present position. This is a proven turnkey business an individual or couple can run. If you purchase our software and business program, we will give you the computer and printer. If you already own a computer, you may receive a discount. You do not need to own, or know how to run, a computer — we will provide free, home office training. Financing available.

To receive free cassettes and color literature, call toll-free:

1-800-343-8014, ext. 82
(in Indiana: 317-758-4415) *Or Write:*
Computer Business Services, Inc.
CBSI Plaza, Ste. 82, Sheridan, IN 46069

Precision Solar Filters

Thousand Oaks Optical solar filters are recognized around the world for their quality, consistent density and even coating across the entire aperture. We specialize in solar filters only and are the largest solar filter manufacturer in the world. Filters are available to fit all brands of telescopes and binoculars. **Thousands of our filters are in use around the world. The preferred choice of telescope dealers and exclusively used by NASA aboard the Space Shuttle.**

GLASS (Full Aperture) Type 1

Made from high quality hand select glass, machine polished and **TRIPLE COATED** with a Nickel-Chromium alloy. Mounted in a machined aluminum cell ready to attach to telescope. Solar image is yellow-orange. No secondary filtering is necessary.

Aperture	Mounted	Aperture	Unmounted
2.4"	$49.00	2.4"	$39.00
3.1"	52.00	3.1"	42.00
3.5" to 4"	59.00	3.5 to 4"	49.00
4-1/4" to 5"	74.00	4-1/4" to 5"	64.00
6"	79.00	6"	69.00
8"	95.00	8"	85.00
10"	109.00	10"	99.00
11"	119.00	11"	109.00
12.5" to 13.1"	149.00	12.5" to 13.1"	129.00
14"	169.00	14"	149.00

40mm to 80mm Binoculars - Mounted .... $92.00 pr.

GLASS (Full Aperture) Type 2

Same as type 1, except stainless steel is combined in the coating to provide an even more durable surface that highly resists wear due to excessive handling and ultraviolet radiation. Solar image is also yellow-orange.

Aperture	Mounted	Aperture	Unmounted
2.4"	$62.00	2.4"	$52.00
3.1"	65.00	3.1"	55.00
3.5" to 4"	76.00	3.5 to 4"	66.00
4-1/4" to 5"	96.00	4-1/4" to 5"	86.00
6"	105.00	6"	95.00
8"	125.00	8"	109.00
10"	139.00	10"	129.00
11"	149.00	11"	139.00
12.5" to 13.1"	179.00	12.5" to 13.1"	159.00
14"	199.00	14"	179.00

40mm to 80mm Binoculars - Mounted .... $115.00 pr.

GLASS (Full Aperture) Type 3

Coated to a neutral density of 4 for serious astrophotographers who desire the shortest possible shutter speeds with slow films. Solar image and optical quality same as type 1 & type 2. Type 3 filters are for photographic use only.

Aperture	Mounted	Aperture	Unmounted
2.4"	$79.00	2.4"	$65.00
3.1"	82.00	3.1"	69.00
3.5" to 4"	99.00	3.5 to 4"	79.00
4-1/4" to 5"	125.00	4-1/4" to 5"	110.00
6"	135.00	6"	115.00
8"	159.00	8"	139.00
10"	172.00	10"	152.00
11"	199.00	11"	179.00
12.5" to 13.1"	229.00	12.5" to 13.1"	209.00
14"	259.00	14"	239.00

Types 1 & 2 are for unlimited visual use and general photographic use. Instructions included with all filters, including tips on solar photography.

5 year warranty on Type 1, 2, & 3 filters
Threaded camera filters also available.

H-ALPHA PROMINENCE FILTERS.
Priced from $699-$859 complete & ready to attach to telescope. Please call or write for additional information.

PRICE GUARANTEE: If you see a lower advertised price on any competitive brand glass filter, simply note the brand and we'll automatically match it.

Our 15th year of manufacturing solar filters.

SOLAR ECLIPSE VIEWERS

Mylar

Aluminized on both sides. Mounted in rigid frame. Mylar window: 1-5/8" x 3-1/8". Each filter supplied in individual envelope. Light transmission is blue.

3" x 5" Overall size .... $1.00 ea.

Plastic

Same as Mylar except this filter yields a sharper image with orange transmission

2-5/8" x 4-5/8" Overall size .... $2.00 ea.

Minimum order of 10 eclipse filters in any combination. Please add appropriate shipping/handling. 10 units: $3.00. Plus $1.00 for each additional 10 units. Minimum credit card order of $25.00. Quantity discounts available starting at 100. Designed for naked eye visual use.

Free brochure available. Foreign inquiries: Please include $1 for return airmail postage of brochure. Proforma invoices available upon request.

30 DAY UNCONDITIONAL MONEY-BACK GUARANTEE

ORDERING INFORMATION: Glass filters are shipped free within the continental U.S. (Please call or write for shipping cost outside of the U.S.) Payment may be made by personal check, bank check or money order. We also accept **VISA, MasterCard and American Express.** (No bank hold on personal checks.)
PLEASE SPECIFY TELESCOPE BRAND AND/OR OUTSIDE DIAMETER MEASUREMENT OF TELESCOPE TUBE. The cost of the filter is determined by the telescope aperture. The mounting cell fits over and around the end of the telescope tube (friction fit). Unmounted filters are the glass filter without a mounting cell.

ORDER TOLL FREE - U.S. & CAN.
(800) 996-9111
ORDERS & INFORMATION: (805) 491-3642
(MON-FRI 10-5 PM PACIFIC)
FAX (805) 491-2393 (24 HOURS)
THOUSAND OAKS OPTICAL
Box 4813 Dept. A • Thousand Oaks, CA 91359

ASTRONOMY Blue Sky Pages

Your guide to local astronomical dealers

ARIZONA

THE ASTRONOMY SHOPPE

- Telescopes • Spotting Scopes
- Binoculars • Maps • Books
- Eye Pieces & Acces.
- "Bigfoot" Mounts
- Custom Optics

15836 N. Cave Creek Road • Phoenix, AZ 85032
602-971-3170

TUCSON'S COMPLETE ASTRONOMY SHOP

- New and Used Equipment
- Meteorite and Meteorite Jewelry
- Books, Posters, Maps & Star-Charts
- Custom Work-Machine & Wood Shop Work Available
- Observatory Construction & Repair
- Observing site and tour guides available.
- Rental equipment available – call for details.
- Repair Work-Telescope Cleaning & Collimating
- Knowledgeable Professional Staff

Stellar-Vision & Astronomy Shop
1835 S. Alvernon #206,
Tucson, AZ 85711 (602) 571-0877

Credit cards accepted. 90 days same as cash.

CALIFORNIA

13th Annual Winter Telescope Demonstration, Star Party & Sale

Sun., Nov. 6 - Sat., Nov. 19

Sat., Nov. 12, 10am-10pm
Celestron Day – Meet the Celestron Rep.
Sat., Nov. 19, 10am-10pm
Meade Day – Meet the Meade Rep.

OPT

Oceanside Photo & Telescope
1024 Mission Ave., Oceanside, CA 92054
(619) 722-3348

FLORIDA

SARASOTA CAMERA EXCHANGE & VIDEO CENTER

1055 South Tamiami Trail
Sarasota, Florida 34236

TELESCOPES
Celestron • New Meade • Tele Vue
Large Accessory Inventory • Used Telescopes
Astrosystems • Telescope Components
Astro Software • Jim's Mobile

BINOCULARS
B & L • Bushnell • Celestron • Leica • Meade
Minolta • Nikon • Pentax • Steiner

Microscopes and Accessories

(813) 366-7484 Call or write Chuck, our dedicated astronomer.

NEW HAMPSHIRE

WE BUY USED TELESCOPES

Q: Why buy from RIVERS?

A: Largest in-store display in New England!
: Full line CELESTRON, MEADE, TELE VUE, PARKS, NIKON dealer
: 30-day exchange!
: Inspection of all goods sold!
: Over 60 years in business!
: Accepts "Trade-ins"
: No sales tax!
: Best of all friendly service!

(603) 742-4888 • FAX: (603) 742-5456

Rivers CAMERA SHOP

454 CENTRAL AVENUE • DOVER, NH 03820

NEW MEXICO

NMA NEW MEXICO ASTRONOMICAL

CELESTRON • MEADE • TELE VUE
PARKS OPTICAL • UNITRON • HOME DOME

SEE THE LARGEST DISPLAY OF TELESCOPES IN N.M.

INDIVIDUALIZED ADVICE FOR THE SERIOUS AMATEUR

Telescopes • Eyepieces • Mounts • Accessories
Books • Sky Atlases • Observatory Fabrication
On-Site Observatory • Regular Star Parties

COME TO THE COUNTRY TELESCOPE STORE AND TEST EQUIPMENT UNDER DARK SKIES!

WE SHIP ANYWHERE AT MAIL ORDER PRICES

834 N. GABALDON RD
BELEN, NM 87002
(505) 864-2953

NEW YORK

BERGER BROS. CAMERA EXCHANGE

TELESCOPES • BINOCULARS • CAMERAS • CAMCORDERS
Over 45 years in business. Honest Reputation.

BERGER BROTHERS CAMERA & VIDEO EXCHANGE
209 Broadway • Amityville, NY 11701 • **Info:** (516) 264-4160
Orders: 800-262-4160 • **Fax:** (516) 264-1007

NORTH CAROLINA

BALL PHOTO (704) 252-2443

• Telescopes up to 14" • Spotting Scopes • Binocs - All Makes • Trade-ins Accepted • Lowest Prices • We Ship Anywhere • In-Store Repair Shop

Oldest & Largest Camera Store In The South
85 Tunnel Road • Asheville, NC 28805

OREGON

NURNBERG SCIENTIFIC
6310 S.W. Virginia Ave. • Portland, Oregon 97201

Call Stan, our astronomy enthusiast, for expert personal assistance in choosing a fine Tele Vue, Meade or Celestron telescope and accessories. We also carry our own full line of microscopes.

(503) 246-8297
Hours: Monday - Friday 8:30 to 4:30

PENNSYLVANIA

OPTICAL GUIDANCE SYSTEMS

Custom-Made Ritchey - Chretien,
Classical Cassegrain and
Newtonian telescopes 10-32 inches.

2450 Huntingdon Pike
Huntingdon Valley, PA 19006
(215) 947-5571

Puzzled about "Blue Sky" advertising?

Let us help you find and fit the missing pieces.

Here are some advantages:

- Ads are separated by state and/or country headings.
- FREE, attention-grabbing blue color.
- A variety of sizes to suit your individual purpose and budget.
- Maximum exposure and response at a low cost.

To advertise call Erik Bergstrom
1-800-558-1544, ext. 538.

ASTRONOMY

Blue Sky Pages

Your guide to local astronomical dealers

PENNSYLVANIA

AMATEUR ASTRONOMERS...

SPECIAL ANNOUNCEMENT!

THE NEW TELE VUE - GENESIS SDF IS NOW IN STOCK!

- **Special Package with GIBRALTAR mount, new Air Chair.**
- **Tele Vue Genesis Solar Kit in stock.**
- **Daystar H-Alpha Filters available.**

★ **See Solar Prominences with the Genesis every Saturday at our showroom.**

★ **Pronto in stock.**

Send SASE for free price list/
$6.00 for complete catalog package

✸ We ship everywhere ✸

SEE OUR AD ON PAGE 23.

Pocono Mountain Optics
RR 6 Box 6329
North Pocono Village Shopping Center
Moscow, PA 18444

Orders Only (800) 569-4323
Info. (717) 842-1500 (9am-9pm) • Fax (717) 842-1408 (24 hrs.)
Showroom hrs: 10-5 Mon. – Sat.

SOUTH CAROLINA

Wonder Works

S.C. LARGEST SELECTION OF TELESCOPES:

Spotting scopes, binoculars & opera glasses

Celestron, Meade, Tele Vue & Nikon Dealers

Best prices, selection assistance,
& free instruction.

PHONE ORDERS WELCOME
OPEN 7 DAYS

280 W. Coleman Blvd.
Mt. Pleasant, SC 29464
800-352-2316

WISCONSIN

EAGLE OPTICS

Binoculars, Telescopes,
Star Charts & Accessories

716 S. Whitney Way
Madison, WI 53711
(608) 271-4751

CANADA

Lire la Nature Inc.

1699 De Chambly, Longueuil
Quebec, Canada, J4J-3X7
(514) 463-5072 • FAX (514) 463-3409

★ Low Prices – Good Service
★ FREE Price List
★ Canada-Wide Delivery
★ SBIG Distributor

MEADE • CELESTRON • LUMICON
KOWA • SBIG • ZEISS • TELE VUE

SBIG

Astronomical Instruments

★ ST-4 Automatic Star Tracker & Imaging Camera
★ ST-4X New Upgrade Model
★ ST-6 Professional CCD Imaging Camera

CALL FOR DEMO DISK ★ SERVICE
★ ACCESSORIES ★ GOOD PRICES

(514) 463-5072

CANADA

Star Gazer Instruments

◊ Telescopes ◊ Binoculars
◊ Accessories ◊ Books
◊ Celestron, Omcon,
1000 Oaks and more!
Canada-wide delivery • (204) 476-3855
Box 1851 • Neepawa, MB CANADA R0J 1H0

1857

HARRISON

Serving Canadians
for over 135 years

Telescopes, Binoculars, Microscopes, Magnifiers, Accessories, Books, Meteorological Instruments, Gadgets, T-Shirts and Sweat Shirts

• Celestron • Minolta • Meade • Bushnell •
• Bausch & Lomb • Pentax • Zeiss • Steiner •

Fast Canada-wide Delivery
Will match any advertised Canadian retail price

Montreal
Fax (514) 341-1184 • (514) 341-2079
8425 Mountain Sights Ave. • Montreal, Quebec H4P 2B9

Vancouver
(604) 737-4303
2574 Granville Street • Vancouver, B.C. V6H 3C8

Meade APD Telescopes

CANADA-WIDE DELIVERY

Bonus Video "How
To Use a Telescope"
with telescope purchase
($39.95 value)

FREE! Discount Price List. Call or Write.
(416) 783-4140 FAX: (416) 783-7697

KHAN SCOPE CENTRE
3243 Dufferin Street
Toronto, Ont. CANADA M6A-2T2

The sky's the limit when you advertise in the..."Blue Sky Pages."

A regular advertising schedule in the "Blue Sky Pages" will attract attention to your business. Your store's name will be directly in front of, and in the minds of, the world's largest audience of active, affluent amateur astronomers.

ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011
CUSTOMER RELATIONS • 212-741-0466 • Mon–Thur. 9–4:30, Sun. 11-2 ET

FAX #
212/ 463-7223

PHONE ORDERS ACCEPTED
DAY OR NIGHT
MON–THURS. 9 TILL 9:30 PM EST
FRI. 9-1:45 • SUNDAY 9:30–6

STORE HOURS:
MON.–THURS. 9–7pm
FRI TO 1:45 • SUN 9:30–5:45

ORDER TOLL FREE • US & CANADA
800-223-2500
ORDERS & INFO
212-741-0052

COMPLETE with MANUFACTURER'S ACCESSORIES

Visit... the greatest telescope display in the Eastern United States

See... our display of the latest design in **computerized** telescope technology of Meade, Celestron, Edmund Scientific, Tele-Vue, Bushnell telescopes and a full line of accessories

Talk... to knowledgeable *telescope sales staff*, who are glad to guide you to a wise purchase.

Meade® THE LEADER'S EDGE

We Carry The Complete Line

We are one of the largest **Meade** stocking dealers on the **East Coast** with the full line of **Meade** on display

Before you make your purchase, call us for our low prices and don't forget to visit our large display of Telescopes. There you can see all the latest wonders from **Meade**

MEADE EYEPIECES Series 4000

CALL FOR REBATES

Super Plossl		Ultra Wide		Super Wide	
6.4,9.7,12.4,15mm	**Call**	4.7mm	**Call**	13.8mm	**Call**
20, 26mm	**Call**	6.7mm	**Call**	18mm	**Call**
32mm	**Call**	8.8mm (1.25"/2")	**Call**	24.5mm	**Call**
40mm	**Call**	14mm (1.25"/2")	**Call**	32mm (2")	**Call**
56mm (2")	**Call**	Barlow 2X Ser 4000	**Call**	40mm (2")	**Call**
Series 3000 Plossls			**Call**		

MEADE TELESCOPE ACCESSORIES

Accs. Case #50	**59.95**
Accs. Shelf f/Field Trpd	**9.95**
Barlow 2X 1.25" #122	**Call**
Barlow 2X,3X 1.25 #127	**Call**
2" Star Diagonal #929	**Call**
Off Axis Guider	**Call**
12mm Illum Reticle w/wire	**Call**
12mm Illum Reticle wireless	**Call**
9mm Illum Reticle w/wire	**Call**
9mm Illum Reticle wireless	**Call**
45° Erect .96"	**44.95**
45° Erect Diag. 1.25"	**47.95**
45° Erect Diag. Hybrid	**39.95**
Diag. Porro Prism 1.25"	**54.95**
Photo Visual Filt Set 4 pc.	**Call**
#1A Sky Filter	**44.95**
#908B Nebular Filter	**Call**
#911B Nebular Filter	**Call**
#908N Nebular	**Call**
#911N Nebular	**Call**
8000 Object Library LX200	**59.95**
Electric Cont. LX6	**199.95**
Electric Focuser #1207	**134.95**
Electric Focuser 1206/1205	**139.95**
Dew Shield (2080)	**103.95**
Dew Shield (2120)	**114.95**
Piggy Bk Brkt 2080/2120	**29.95**
Tube 1401 Weight Set	**84.95**
Tube 1402 Weight	**89.95**
Tele Extender	**Call**
Tele Extender Variable	**Call**
6x30 Viewfinder	**Call**
8x50 Viewfinder	**Call**
9x60 Viewfinder	**Call**

Meade Reflectors / Refractors

4.5 Reflector. w/Equatorial Mount	**Call**
60mm Altazimuth Refractor	**Call**
60mm Equatorial Refractor	**Call**
90mm Altazimuth Refractor	**Call**
90mm Equatorial Refractor	**Call**
Basic Camera Adapter 1 1/4"	**29.95**
Variable Projection Camera Adapter 1 1/4"	**39.95**
JMI Motor Drive for 395/285/4500	**79.95**

SPOTTING SCOPES

2045S Spotting Scope	**Call**
97E 3.5 M/C	**Call**
Case for 2045S	**44.95**
97ER	**Call**

Celestron

5" compact scope
C5 1250 F/10 Schmidt Cassegrain with Starbright coating.
Available in 3 versions:

C5 Telescope w/AC Drive	**Call**
C5+Telescope w/DC Drive	**Call**
C5 Spotting Scope	**Call**
C5 Tripod	**239.95**
Radial Guider C5	**119.95**
DEC Motor C5	**99.95**
JMI Focus Motor CS	**109.95**
Carry Case for C5/C5+	**139.95**
Piggyback Counterpoise C5	**64.95**
Advanced Astro Master f/C5	**549.95**

Celestron Reducer/Corrector f/6.3

This combination focal reducer and field corrector lens accessory works with all Celestron and Meade Schmidt Cassegrains. Now it is possible to have a dual focal ratio instrument without sacrificing image quality. The Reducer/ Corrector is f/6.3 for C8 and C11, f/7 for C14. A four element, fully multi-coated accessory. Results are amazing BOTH visually and photographically.

114⁹⁵

New CCD AUTOGUIDERS

Adorama has entered the CCD Imaging field. You can now get the latest in CCD at Adorama's renowned most competitive pricing *CALL*

BAUSCH & LOMB BUSHNELL

DISCOVERER

DISCOVERER with 15-60x Zoom	**176⁹⁵**
Discoverer Case	**44.95**
Tamrac Case for Discoverer	**19.95**
Camera Mount	**18.95**
Car Window Mount	**34.95**

ELITE PC

611548PC #ELITE with Zoom E.P.	**Call**

NEW PREMIER

Premier HDR 15-45 x 60	**Call**

SPACEMASTER (60mm)

Spacemaster	**147.95**
New **Spacemaster ED**	**294.95**
Spacemaster Rubber Armored	**164.95**
Spacemaster with 15-45x, Table Tripod & Case	**244.95**
Spacemaster Rubber with 15-45x Table Tripod & Case	**259.95**

SPACEMASTER ACCESS.

15, 20, 25, 40 & 60x EP	**34.95**
22x Wide Angle	**48.95**
15-45x Zoom Eye Piece	**83.95**
Camera Mount	**29.95**
Baush & Lomb Elite 77mm Spotting Scope	**Call**
77mm S. S. Elite	**Call**

Tele Vue®

NEW PLOSSL

55mm 2"	**Call**
40, 32mm 1 1/4"	**Call**
26, 21, 17, 13mm 1 1/4"	**Call**
10.5, 7.4mm, 1 1/4"	**Call**

NEW PANOPTIC

New 15mm 1 1/4"	**Call**
New 27mm 1 1/4"	**Call**
22mm 1¼"	**Call**
35mm 2"	**Call**
Panoptic Barlow Interface 2"	**Call**

BARLOW

2.5X, 1.8X 1 1/4"	**Call**
Big Barlow 2x 2"	**Call**

NAGLER

20mm Type 2; 2"	**Call**
16mm Type 2; 2, 1 1/4"	**Call**
12mm Type 2; 2, 1 1/4"	**Call**
13mm 2" & 1 1/4"	**Call**
9mm 2" & 1 1/4"	**Call**
7mm 1 1/4"	**Call**
4.8mm 1 1/4"	**Call**

ACCESSORIES

2" Star Diagonal	**Call**
Rich Field Kit w/New 55 Plossl 2" S.D., Adapt, 2" to 1 1/4" Adapt	**339.95**
1¼" E.P. Adt. f/Questar	**59.95**

PARACORR COMA CORRECTORS

1 1/4"	**Call**
2"	**Call**

TELE VUE REFRACTORS

Genesis™-sdf

GENESIS SDF Fluorite-APO	**Call**
GENESIS Fluorite	**Call**
GENESIS-SDF Outfit w/Sky Tour Computer & Gibraltar Mt.	**Call**

PRONTO 70mm Aperture f/6.4 w/ED Glass

PRONTO w/2" star diagonal & 21mm Plossl	**Call**
PRONTO w/1.25" erect prism & 21mm Plossl	**Call**
PRONTO w/1.25" Star Diagonal & 21mm Plossl	**Call**

MOUNTS & ACCESSORIES FOR TELE VUE REFRACTORS

New SKY TOUR Computer–Call for details

GIBRALTAR MOUNT	**439⁹⁵**
Gibraltar Mount with Sky Tour Computer	**Call**
Starbeam ."Red Star" Projection Finder	**Call**
Piggy-Cam .Camera Adapter	**41.95**

CELESTRON TELESCOPE ACCS.

AC Adpt. C5+, C8+ Ultima	**27.95**
Car Bat. Adpt. C5+,C8+ Ultima	**27.95**
Improved Accs Cs.	**44.95**
Barlow 1 1/4" 2x MC	**54.95**
12AH 12V DC Batt.	**59.95**
Counterweight Bar Assembly 8" **64.95** 11"	**64.95**
DC Inverter	**84.95**
Diagonal Erect 1.25"	**41.95**
Dewstar/Shade 8"	**26.95**
Dual Axis Drive SP/GP	**259.95**
7x50 Finder Scope with Illuminator & Bracket	**159.95**
Quick Release f/7x50 find	**47.95**
LED Flashlight	**16.95**
LPR A **54.95** LPR B	**79.95**
Piggyback Mt 8"	**34.95**
Piggyback Bar Assembly 11"	**64.95**
Polarizer Set 1 1/4"	**46.95**
Series 6 Filter Set	**59.95**
Stereo Binocular Viewer	**449.95**
Star Diag 1.25" MC	**47.95**
New Improved 2" Mirror Star Diagonal w/1.25" Adapt.	**124.95**
Great Polaris 8" Mount with Polaris Finder	**649.95**
Sky Filter #2	**39.95**
Adj. Tripod Rubberized	**259.95**
Camera Adapt. Tele Extender .96"	**24.95**
Tele Extender	**24.95**
Tele Extender Deluxe	**43.95**
T. Adapter f/Schmidt Cassegrains	**24.95**
Vibration Suppression Pads	**39.95**
Wedge f/C8	**87.95**

CELESTRON MYLAR SOLAR SCREEN FILTERS (MOUNTED)

f/C11 (5" O.A.)	**119.95**	f/C90s	**64.95**	f/C5/C5+	**79.95**
f/C4.5	**69.95**	f/C90RC GPC102	**69.95**	f/C8's	**99.95**

CELESTRON 1¼" EYEPIECES

Deluxe zoom Ocular 6.5-18mm Ortho	**119.95**

ULTIMA EYEPIECES

5mm, 18mm, 1 1/4"	**79.95**	7.5, 12.5mm, 1 1/4"			**73.95**
24mm, 1 1/4"	**79.95**	30mm, 1 1/4"	**92.95**	35m 1¼"	**119.95**
42m 1¼"	**109.95**			80mm 2"	**219.95**
Ultima 2X Barlow Short Tube Version)					**64.95**

New PLOSSL EYEPIECES

7.5, 10, 17, 26mm, 1 1/4"	**49.95**	40mm, 1 1/4"	**59.95**

Vixen Lanthanum Eyepieces LV Series

2.5, 4mm, 1.25"	**107.95**	5, 6, 9, 10, 15mm, 1.25"	**96.95**
20, 25mm, 1.25"	**108.95**	30mm, 2"	**139.95**

CELESTRON®

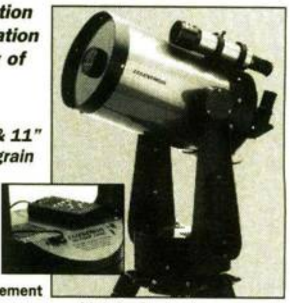
Adorama Proudly Presents...

The Celestron Ultima 2000

Your introduction to the Information Superhighway of the Stars

Computer Automated 8" & 11" Schmidt-Cassegrain Telescopes

The Ultimate in Simplicity & User Friendliness



Just find two allignement stars with the finderscope and let the fun begin

• 10º per second fast slewing speed • 4 Speeds • Ultra smooth and extremely quiet motor • Database of over 10,000 objects • Sky tour feature • RS-232 Port for computer connectivity • Extremly portable.

New Ultima 2000 8"	**2495.00**
New Ultima 2000 11"	**3695.00**
Ultima Deluxe Wedge	**379.95**
Ultima Economy Wedge	**229.95**

• •

SCHMIDT CASSEGRAIN TELESCOPES

CG-11 Telescope	**Call**
G-11 Mount only	**1599.95**
Ultima 8 P.E.C.	**Call**
Powerstar 8 P.E.C.	**1399.95**
New C8+ Telescope	**Call**
New C8+ Computerized Telescope	**Call**
JMI DEC Motor C8+ / Classic 8	**74.95**
JMI Focus Motor C8+ / Classic 8	**79.95**
CLASSIC 8 with Star Bright Coating Outfit w/Wedge	**Call**
DEC Motor for Classic	**89.95**
8" f/10 Schmidt Cassegrain Optical Tube Assembly with 6x30 Finder, 26mm 1.25", Star Diagonal 1.25", Footlocker Case	**Call**
8" Optical tube as above with star bright coating	**Call**

ADVANCED ASTRO MASTER

New Advanced Astro Master f/fork mounted C8s	**469.95**
for SP Mounts	**439.95**
for GP Mounts/GII	**549.95**

COMA CORRECTOR

With 1¼", 2" Eyepiece & Focus Adapter	**149.95**

RADIAL GUIDER

Allows free movement of guider while camera is fixed	**114.95**

Multi Function Focal Tester 55

Focus on & off the optical axis at 3,16,22 & 30mm Diam. in a single setup only	**134.95**
6mm Illum. Reticle w/moveable reticle	**159.95**
Milro Guide Eyepiece	**159.95**

NEW Alt Azimuth Mount w/Slow motion Control	**279.95**

REFLECTOR TELESCOPES

New GP-200 7.9" f/4 Reflector	**Call**
C4.5" Newtonian	**Call**
New 4.5" Newtonian Telescope	**Call**
Motor Drive f/C4.5 Comet Catcher	**169.95**
Polar Axis Fndr w/Illum f/SP, GP Mounts	**94.95**
Tele Extender Refractor/Newtonian	**59.95**

REFRACTOR TELESCOPES

Great Polaris C102 102mm	**Call**
Firstscope 80 w/45 Erect Prism	**Call**
T Adapter Refractor/C4.5	**44.95**
C60 Altazimutzh	**169.00**
New Firstscope 60	**129.00**
60mm Equatorial	**279.00**
Image Erector f/60mm Ref	**9.95**

SPOTTING SCOPES

All the C90s Include: 8x20 Erect Image Finder, 45° Erect Image Diagonal, 30mm, .96" E.P., Foam Fitted Case

C90	**Call**
C90 MC	**Call**
C90MC w/1.25" Accs.	**Call**
C90MCRC w/1.25" Accs.	**Call**
New S-80 1.25" Spotting Scope	**Call**
New S-80+ 1.25" Spotting Scope	**Call**
500 f/5.6 Telephoto	**279.95**
f/4 Adapter for 500/5.6	**74.95**

CELESTRON C90 & SPOTTING SCOPE ACCS.

New Barlow .96, 2x M/C	**44.95**
7.5, 10, 17, 26 Plossl .96	**47.95**
6, 9, 12 Ortho, .96	**34.95**
10, 18, 25, 30, 40 Klnr.96	**32.95**
Lens Shade C90	**54.95**
Polarizer Set .96	**32.95**
Star Diagonal .96	**29.95**
Diag Prism 45° .96	**46.95**
1.25" Diag Prism 45° .for C90	**39.95**
Series 5 Filter Set	**49.95**
Shoulder Mount	**69.95**

Edmund Scientific **Astroscan 2001** **299⁹⁵**

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY

No Surcharge for MasterCharge or VISA Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14-day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. **Prices effective til Sept. 20, 1994** **Please address all inquiries and orders to ASTRO DEPT. #55**

ADORAMA

42 West 18th Street • New York, NY 10011 10

ORDER TOLL FREE **800-223-2500**

ORDERS & INFO **212-741-0052**

FAX # 212-463-7223

TELESCOPE ACCESSORIES

LUMICON

UHC PREMIUM FILTERS		DEEP SKY PREMIUM FILTERS			
1 1/4"	**99.50**	.96"	**59.50**	1 1/4"	**79.50**
48mm f/most 2" EP	**199.95**	2"	**119.50**	48mm	**119.50**

FILTER SET 1.25" (UHC with Deep Sky) **159.50**

H-BETA				OXYGEN III			
1¼"	**99.50**	48mm	**199.50**	1¼"	**99.50**	48mm	**199.50**

JIM'S MOBILE

DEC. MOTOR/NGC Computers		FOCUS MOTOR	
f/Meade LX3/5/6/MTS	**69.95**	f/Meade LX5/6	**74.95**
DSC-Max	**488.**	f/Meade LX200	**79.95**
NGC Micro Max	**439.**	**NEW MOTOR TRACK V**	
NGC Mini Max	**549.**	Motor Track V	**Call**
NGC-Max	**749.00**		

FOCUSERS

NGF-1	**209.**	NGF-2	**159.**	NGF-3	**135.**
NGF-4	**109.**	NGF-S	**279.**		

NEW 1.25" NGF FOCUSERS

NGF-1 Mini	**151.95**	NGF-2 Mini	**114.95**	NGF-S Mini	**184.95**

TELRAD		KWIK FOCUS	
Finder with Mounting Base	**41.95**	Lens Cap 8"	**29.95**
Spare Mounting Base	**7.95**	Lens Cap 10"	**34.95**
Dew Shield for Telrad	**11.95**		
Pulsar Unit	**19.95**		

IDAI MIRRORS

IDAI 4.5" f/7.8 (860mm focal leng.) w/Matching Elliptical Flats **69.95**

MEADE PARABOLIC MIRRORS

6" f/8	**139.95**	8" f/6	**194.95**	10" f/4.5	**399.95**
6" f/5	**139.95**	10" f/6	**389.95**		

MEADE ELLIPTICAL FLAT SECONDARY MIRRORS

1.3"	**26.95**	1.83"	**37.95**	2.6"	**53.95**
1.52"	**35.95**	2.14"	**45.95**	3.1"	**84.95**

MEADE RACK & PINION FOCUSER

#67 1 1/4"	**58.**	#680 2"/1.25"	**89.95**	#682 2"	**99.**

beattie **BEATTIE INTERSCREEN PLUS** (4x Brighter)

f/Nikon F, F2, F3, F4	**89.95**	f/Olympus OM1,2,3,4	**62.95**
f/Nikon FE/FE2/FM/FM2/FA	**58.95**	f/Nikon N90	**66.95**
f/Canon EOS	**63.95**	f/Nikon 8008	**62.95**

ASTRONOMY BOOKS

BOOKS FOR BEGINNERS

How to Choose a Binocular	4.95
The Facts on File Atlas of Stars and Planets	16.95
Astronomy for the Beginners by Patrick Moore	12.95

BINOCULAR OBSERVING

Deep-Sky Objects f/Binoculars by John T. Kozak	10.95
Binocular Astronomy	24.95
Touring the Universe Through Binoculars	29.95
Exploring the Night Sky with Binoculars	4.95

STAR ATLASES

Sky Atlas 2000 Deluxe Edition *by Wil Tirion*	39.95
Sky Atlas 2000 Field Ed.	18.95
Laminated Sky Atlas 2000 Field Edition	59.95
Sky Catalogue 2000. Vol. 1– 2nd Ed. (paperback)	34.95
Sky Catalogue 2000. Vol. 2– (paperback)	29.95
Bright Star Atlas 2000	9.95
Edmund Mag 6 Star Atlas	18.95
Celestron Sky Map	15.95
Uranometria 2000 Volume 1 or Vol. 2	39.95
Deep-Sky Field Guide to Uranometria 2000	49.95

OBSERVERS' HANDBOOKS

The Backyard Astronomer's Guide	38.95
1000+: The Amateur Astronomer's Field Guide to Deep-Sky Observing	34.95
The Sky: A Users Guide	27.95

Nightwatch *by Dickinson*	24.95
Atlas of Deep-Sky Splendors, 4th Edition	36.95
The Messier Album	19.95
Visual Astronomy of the Deep Sky *by Roger Clark*	39.95
Observing Handbook and Catalogue of Deep-Sky Objects	49.95
Fifty Year Canon of Solar Eclipses: 1986-2035	24.95
Fifty Year Canon of Lunar Eclipses: 1986-2035	19.95
Burnham's Celestial Handbook 3 Vol. Set	38.95
A Concise Dictionary of Astronomy	24.95
Lunar Source Book: User's Guide to the Moon	59.50

Astrophotography & Imaging

A Manual of Celestial Photography	12.95
Astrophotography, 2nd Ed. *by Barry Gordon*	18.95
Astrophotography II	18.95
Handbook for Star Trackers *by Jim Ballard*	12.95
Astrophotography for the Amateur (Hard)	39.95
A Manual of Advanced Celestial Photography	47.95

ASTRONOMY SOFTWARE

New Dance of the planets QED with Observer Companion **159.95**

Dance of the planets QED w/Observer Companion & Star 8 Ext.	**184.95**
The Sky DOS level 2	**Call**
The Sky DOS level 3	**Call**
The Sky Windows level 2	**Call**
The Sky Windows level 3	**Call**
LX-200 Interface	**59.00**
New Sky GSC (CD ROM)	**Call**
PC Sky	**79.95**

VIRTUAL REALITY

Mars Explorer (CD ROM)	**49.95**
Distant Suns (Disk)	**49.95**
Distant Suns (CD ROM)	**99.95**
Vista Pro (Disk)	**84.95**
Vista Pro (CD ROM)	**94.95**

TELESCOPE ACCESSORIES

DEW SHIELD

Collapsible, fold down easy to store and transport

for Celestron C90	**18.95**	for Meade 2045	**18.95**
f/8" Schmidt Cassegrains	**28.95**	f/10" Schmidt Cassegrains	**38.95**
f/5" Scopes	**24.95**	f/11" Scopes	**49.95**

Heavy Duty Rechargeable DC Power Pack

12 Amp Unit	**86.95**
DC Power Invertor Converts your AC Driver to 12Volt DC	**74.95**
Voltage and Frequency Converter Converts 110V to 220V	**89.95**

EYEPIECE FILTERS 2", 1¼" & .96"

(Not all filters available in .96" & 2")

Avail. in the following colors: 1A Skylight; 8 Yellow; 12 Deep Yellow; 15 Deep Yellow; 21 Orange; 23A Red; 25 Red; 38A Blue; 47 Violet; 56 Light Green; 58 Green; 80A Light Blue; 82A Pale Blue; ND 0.3; ND 0.6; ND 0.9

.96" & 1.25"	Ea. **12.95**
Polarizer 1 1/4	**13.95**
2" (Limited Availability)	Each **17.95**
Buy any 4 filters (1.25")	for only **39.95**
Buy any 12 filters	for only **114.95**

SOLAR FILTER

by Thousand Oaks Optical

GLASS TYPE 2 Stainless Steel Coated MOUNTED

3.1"	64.95	3.5"/4"	75.95	5"	95.95
6"	104.95	8"	114.95	10"	127.95
11"	149.95				

New H-Alpha Solar prominence filter w/white light Pre Filter 8" .... **695.**

BINOCULARS

FUJINON FMT-SX Binoculars

6x30 FMTR-SX w/Rubber Coatings & fashion strap	**344.95**
7x50 FMT-SX with Carry Case & fashion strap	**374.95**
7x50 FMTR-SX w/Rubber Coating & fashion strap	**418.95**
7x50 FMTR-CSX R.C.with Compass & fashion strap	**478.95**
8x30 FMTR-SX Rubber Coated & fashion strap	**345.95**
10x70 FMT-SX with Carry Case & fashion strap	**478.95**
16x70 FMT-SX with Carry Case & fashion strap	**529.95**

Tripod Adapter **16.95**

CELESTRON

GIANT

NEW MULTI-COATED

11x80 MC	**299.95**
15x80	**309.00**
20x80 MC	**329.00**
Solar Filter f/11x80,20x80.	**64.95**
LPR filter set f/above.	**99.95**

ULTIMA SERIES

7x42	**Call**	8x32 w.a.	**Call**
7x50	**Call**	10x42w.a.	**Call**
10x50	**Call**	8x56	**Call**

PRO SERIES

7x50	**Call**
9x63	**Call**
10x50w.a.	**Call**
12x50w.a.	**Call.**
8-24x50	**Call**

ED GLASS SERIES

6.5x44	**395.**	9.5x44	**395.**

New MINI w/Rubi Coating

8x21	**65.**	9x25	**75.**

KOWA

SPOTTING SCOPES w/20-60x zoom

TSN-1	**579.95**	TSN-2	**564.95**
TSN-3	**974.95**	TSN-4	**944.95**

without Eypieces

TSN-1	**389.00**	TSN-2	**375.00**
TSN-3	**799.00**	TSN-4	**779.00**

BINOCULAR ACCS

Car Window Mount	**34.95**
Tripod Adapter	**16.95**

NIKON

10x70 SP w/case **949.95**

SPOTTING SCOPES

15-45x60 Spotter R/C	**294.95**
15-45x Angle	**329.95**
20x Eyepiece	**46.95**
Photo Adapter f/SS	**49.95**

New Fieldscope Super 80

Super 80 with 20X-60X	**689.95**
Super 80 ED with 20X-60X	**1069.95**

FIELD SCOPES (Body only)

Field Scope II	**259.95**		
Field Scope ED II	**519.95**		
Field Scope Angle	**299.95**		
Field Scope Angle ED	**569.95**		
New Field Scope ED 78mm	**919.95**		
New F.S. ED 78mm Angle	**979.95**		
15, 20, 30, 40X E.P.	@ **64.95**		
60X	**69.95**	30X WA	**126.95**
20-45X Zoom E.P.	**144.95**		

ZEISS

W/O CASE

8x56 CF GA	**879.95**
15x60 CFT GA	**1449.95**
New 15x60 "B" for Eyeglass Wearers	**1699.95**

LEICA

7x42 GEOVID **3449.95**

SWIFT

GIANT

Observer 11x80 BCF **289.95**

SPOTTING SCOPES

Lynx 20x-65X **249.95**

New NIGHT VISION Scopes & Binoculars

with these Night Vision aids you can see up to 200 feet in complete darkness

TEC-2 Owl Night Vision Scope 2.3X	**399.95**
Falcon Night Vision Binoculars 2.5X	**599.95**
Eagle Night Vision Scope 2.3X Camera Compatible	**599.95**

Pro-Optic

Astronomical Accessories

Adorama Exclusive

Adorama is pleased to introduce the Pro-Optic line of telescope accessories. Pro-Optic offers a unique combination of high quality with economical prices

Pro-Optic Plossl 1.25" Eyepieces

The Plossl design has earned a reputation for its image sharpness. However, many astronomers were turned away by its high prices. Now you can can have the Pro-Optic Plossls at prices which are lower than what you would expect pay for eyepieces of inferior quality. *Field of View is 50°.*

25mm Plossl 1.25"	**41.95**	17mm Plossl 1.25"	**41.95**
10mm Plossl 1.25"	**41.95**	7.5mm Plossl 1.25"	**41.95**

New 40mm Plossl 1.25" (Field of View 40°) .... only **64.95**

BUY ONE EYEPIECE AND GET THE SECOND ONE (of equal value) AT HALF PRICE!

Pro Optic 500mm f/5.6 Maksutov Telephoto/Spotting Scope

With high-tech white finish

Carry Case
Pro-Optic

Multi-coated to maximize contrast and sharpness and a built-in field flattener to reduce field curvature.
With its 500mm focal length, it is long enough for close-ups of far away objects but with the f/5.6 optics it is fast enough to be hand held, focuses as close as 5 feet.
With the addition of the 'SS500 Kit you can convert it to a 20X 90mm spotting scope.
The SS500 kit includes a 45° 1.25" Erect Image Diagonal and a 25mm 1.25" Plossl

Pro-Optic 500mm f/5.6 lens	**249.95**
Pro-Optic SS500 Kit (when purchased w/500/5.6)	**49.95**
350mm f/4 Converter for 500/5.6	**74.95**

Pro-Optic Slow Motion Control

With the Slow Motion control attached between your Lens/Spotting Scope and your photographic tripod, you can make accurate slow motion adjustments in altitude and Azimuth in addition the Pro-Optic SMC allows you to make major adjustment in elevation with a separate control knob.
The Slow Motion Control fits any tripod with 1/4-20 thread.

Pro-Optic Slow Motion Control **39⁹⁵**

Pro-Optic 45º Erect Image Diagonal

Provides an ideal 45° angle for erect image terrestrial viewing

Pro-Optic 45° Erect 1.25"	42.95
Pro-Optic 45° Erect Hybrid (1.25" to .96")	39.95
Pro-Optic 90° Star Diagonal 1.25"	34.95

Attache Style

New **Pro-Optic** Deluxe Aluminum Eyepiece Case 14⅜ x 11⅜ x 5⅜" **$49⁹⁵**

Deluxe Large Case 18" x 13" x6" **$59⁹⁵**

SEE OPPOSITE PAGE FOR ORDERING INSTRUCTIONS

ASTRONOMY

Adorama 104, 105
Arkatents USA 80
Astronomical Enterprise 99
Astronomics 99
Astronomy Shoppe 102
AstroSystems, Inc 85
B. Crist Miniatures 85
Ball Photo 102
Berger Brothers 102
Bethany Sciences 86
Black Forest Observatory 12
Blue Sky Pages 102, 103
Bob Hoorell Custom Woodworking 84
California Telescope Co 99
Celestron International 19, 89, 108
Central Camera Co 85
Compuscope 21
Computer Business Services 101
Coulter Optical Inc 92
Dallas Remote Imaging 85
Davis Instruments 94
Delphi 25
Dew Remover System 85
Dino Productions 85
ELB Software 12
Eagle Optics 103
Allen Eaton 16
Edmund Scientific Company 27
Electrim Corporation 16
Energy Controls Inc 86
Environmental Films 15
FC Meichsner Company 12
Focus Camera 96, 97
Gibeon Designs 84, 86
Robert A. Haag-Meteorites 84
Ed Hamilton, Bookseller 85
Harrison 103
Helmer Publishing 84
Innovative Technologies 84
International Network Enterprises 90
Jim Johnston 84
Jim's Mobile (JMI, Inc.) 13
KC Woodsmith 86
Kalmbach Publishing Co 87, 93, 100
Kensington Optics 86
Khan Scope Center 103
Killgore Southwest 85
La Maison De L'Astro 90
Learning Technologies Inc 86
Let's Talk Travel 85
Lire La Nature 103
Light Speed Telescopes 80
Lumicon 78, 79
Main Sequence 86
Marketplace, The 84, 85, 86
Meade Instruments 2, 3, 7, 8, 9, 10, 11
Mountain Press Publishing 80
Mountain Skies Astronomical Society 86
Murnaghan 90
New Mexico Astronomical 84, 102
Novagraphics 86
Nurnberg Scientific 102
Oceanside Photo & Telescope 102
Optical Guidance Systems 102
Orion Telescope Center 60, 61
Pegasus Classifieds 85
Pocono Mountain Optics 23, 103
Precision Optics 21
Rainbow Symphony, Inc 84
Reader's Exchange 27
Rivers Camera Shop 102
Sarasota Camera Exchange Inc 102
Science Connection 86
Scope City 93
Shutan Camera & Video 14
Software Bisque 17
Software Systems Company 94
Spectra Astro-systems 80
Star Gazer Instruments 103
Star Gazer Steve 16
Starry Messenger 85
Starsplitter Telescopes 85
Stellar Vision 102
Sunny Dial 86
Tech 2000 101
Technical Innovations 94
Tele Vue Optics, Inc 107
Thousand Oaks Optical 101
Turner Home Video 91
Tuthill, Roger W. Inc 21, 90
Urania 84
Vanguard Electronic Labs 84
Wholesale Optics (Pauli's) 95
Wilderness Travel 86
Wolf 359 93
Wonder Works 103
Zephyr Services 88

READINGS & CREDITS

Moondust (page 28)

Atlas of the Moon by Antonín Rükl, (Kalmbach, 1992) shows Reiner Gamma plotted on chart 28.

The Geologic History of the Moon by Don E. Wilhelms, (U.S. Geological Survey Professional Paper 1348, 1987) discusses lunar swirls and magnetic fields on pages 256-258 and elsewhere.

Black Holes (page 36)

Black Holes and Warped Spacetime by William J. Kaufmann III (W.H. Freeman, 1979) provides an entertaining look at how astronomers viewed black holes in the glory days of the 1970s.

Observatories (page 56)

"Building Owl Observatory" by Jim Krick, ASTRONOMY, April, May, and June, 1992, details building a roll-off roof observatory with folding walls.

B/W Deep Sky (page 62)

Astrophotography for the Amateur by Michael Covington (Cambridge, 1991) introduces astrophotographic methods, including prime focus deep-sky work.

Bright Lights (page 68)

Visual Astronomy of the Deep Sky by Roger N. Clark, (Cambridge University Press, 1990) primes observers for the deep-sky with equipment and technique tips.

"ASTRONOMY Tests Ten Nebula Filters," by Alister Ling and Jerry Spevak, ASTRONOMY, February, 1991, contains data about specific light pollution filters.

Southern Sky (page 72)

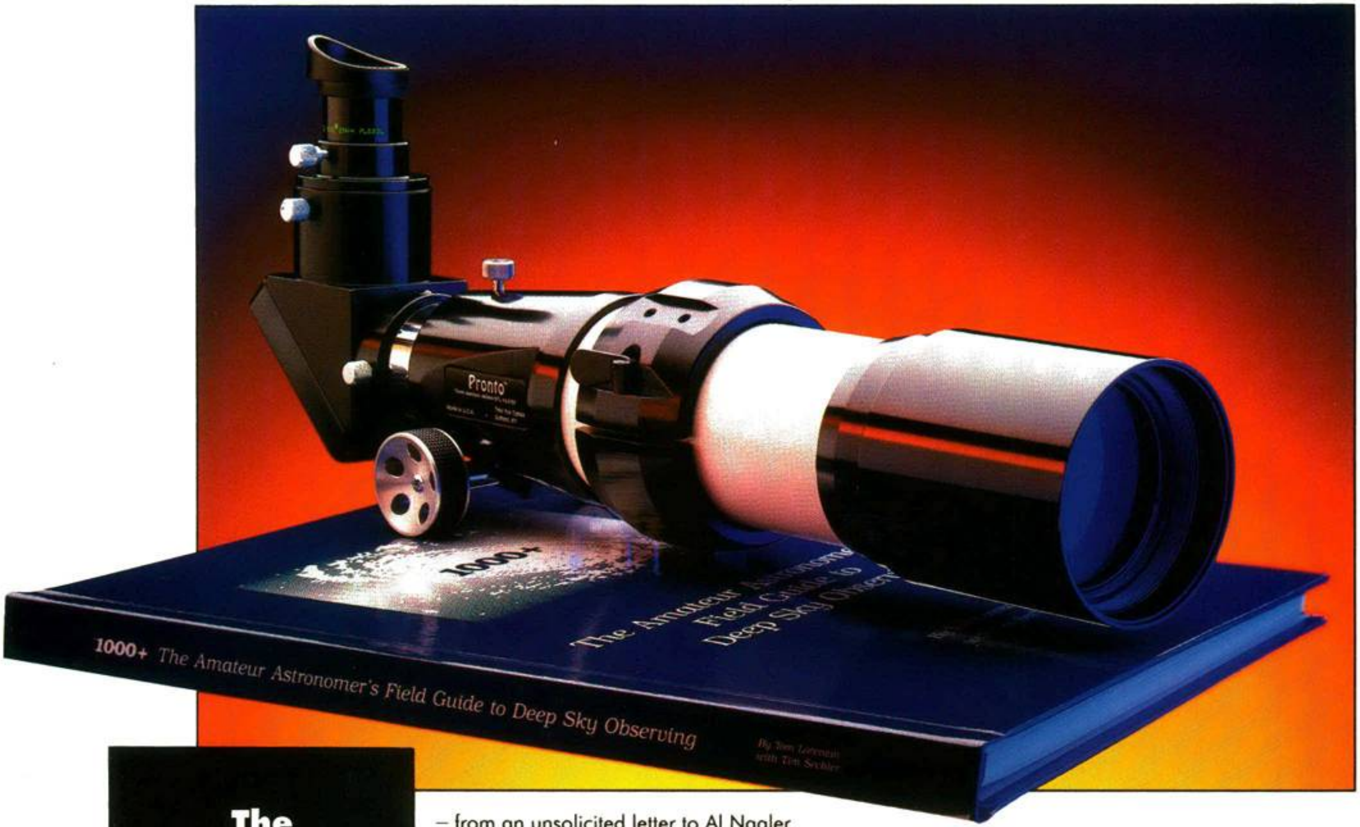
The Southern Sky Guide by David Ellyard and Wil Tirion, (Cambridge University Press, 1993) has all-sky star charts for two-week intervals and more detailed maps for finding binocular objects.

"Exploring the South Polar Stars" by Deborah Byrd, ASTRONOMY, September 1993, provides a star chart and instructions for navigating the southern sky.

Cover: NASA/HST; **p. 4, left:** L. Eduardo Vega; **top:** NASA/HST; **bottom:** Luke Dodd; **p. 5:** NASA; **p. 18, top:** European Southern Observatory (ESO); **middle:** G. Bryan and M. Norman, University of Illinois at Urbana; **p. 20, top:** ESO; **bottom:** Sally Heap, NASA/GSFC/LASP, and NASA; **p. 22, top:** Robert Burnham; **bottom:** John Shibley; **p. 24, top:** Somak Raychaudhury (SAO), et al.; **bottom:** Maria Zuber, Johns Hopkins Univeristy, et al.; **p. 26:** Antonella Nota (STScI/ESA) and NASA; **pp. 28-29:** NASA/Lunar Orbiter IV frame H-157; **p. 30:** NASA/Apollo 17 frame AS17-151-23185; **p. 31:** Phil Kirchmeier after Lon Hood; **p. 32:** Thomas L. Hunt after Lon Hood; **p. 33, top:** NASA; **bottom:** Phil Kirchmeier after Lon Hood; **p. 34:** NASA, **p. 35:** Phil Kirchmeier after Lon Hood; **pp. 36-39:** Greg Kot; **p. 40:** Heidi Hammel, MIT/NASA/HST; **p. 41, series:** Calar Alto Observatory; **bottom:** ESO; **p. 42:** Heidi Hammel, MIT/NASA/HST; **p. 43:** NASA/HST; **p. 44:** NASA/HST; **p. 45, series:** Kaz Sekiguchi, SAAO; **bottom:** University of Arizona Observatories at Kitt Peak; **p. 49:** Seth Horowitz, 135mm lens at f/2.8, Tri-X film, 23-sec. exposure; **p. 50:** Keith Ward; **p. 51:** Martin Hale, December 21, 1987; **pp. 56-57:** L. Eduardo Vega; **p. 58, top:** Gary Eklund; **bottom:** William Freeman; **p. 59, top:** Don Trombino; **bottom:** Ron McClung; **pp. 62-67:** Martin C. Germano; **pp. 68-69:** Bruce Bond; **p. 70, left:** Michael Porcellino; **pp. 70-71:** Phil Kirchmeier; **pp. 72-77:** Jim Barclay; **p. 72**: 135mm lens at f/2.8, 30-minute exposure on Fujichrome 400, copied onto slide duplicating film; **p. 73, top:** 28mm lens at f/2.8, Fuji HG 400 film; **bottom:** 135mm lens at f/2.8, 30-minute exposure on Fujichrome 400; **p. 74:** 13-inch f/5.7 telescope, Fuji Professional 1600 film; **p. 75, top:** 20-minute exposure on Kodachrome 64 film; **bottom:** 50mm lens at f/2, 30-minute exposure on Agfa RS 1000 film; **p. 76, top left:** 13-inch f/5.7 telescope, 1-hour exposure on 3M 1000 film; **bottom left:** 50mm lens at f/1.7, 30-minute exposure on Fuji 3200 film; **pp. 76-77:** 200mm lens at f/2.5, 30-minute exposure on Konica SRV 3200 film; **p. 81, top:** Richard Levine, composite photo made with 630mm lens at f/11 to record the Sun; foreground shot on Ektachrome 100 film on May 10, 1994, from Columbus, New Mexico; **middle:** Dan Koehler, 5-inch f/6 lens, Fuji Velvia film, 1/30-sec. exposure taken on May 10, 1994, from Toledo, Ohio; **bottom:** Victor C. Rogus, 5-inch f/9 refractor, composite photo consisting of images taken every 10 minutes on May 10, 1994, from Des Plaines, Illinois; **pp. 82-83, top:** Mark Killion, composite photo made with a 3.5-inch Maksutov-Cassegrain scope, Ektachrome 100 film, and exposures ranging from 1/60-sec. to 1/4-sec., taken on May 10, 1994, from Paris, Illinois; **bottom:** Douglas K. Gilchrist, composite photo taken a 28mm lens at f/11 and exposures of 1/250-sec. on May 10, 1994, from Clinton, Pennsylvania; **p. 82, top:** Nancy Eicher, taken on May 10, 1994, from Oxford, Ohio; **bottom:** Jacques Guertin, 6-inch Maksutov-Cassegrain scope at f/64, hydrogen-alpha filter, Kodacolor 100 film, 2-sec. exposure taken on May 10, 1994, from El Paso, Texas; **p. 92:** Chris Becker; **p. 98:** Jim Forbes.

PRONTO

Pronto: 70mm Ap., 480mm F.L., f/6.8 E.D. doublet, 2" diagonal, 21mm Plössl, adapter, mount ring, shoulder bag all std.


Pronto
1000+
The Amateur Astronomer's Field Guide to Deep Sky Observing
1000+ The Amateur Astronomer's Field Guide to Deep Sky Observing

The Little Scope That Could.

– from an unsolicited letter to Al Nagler

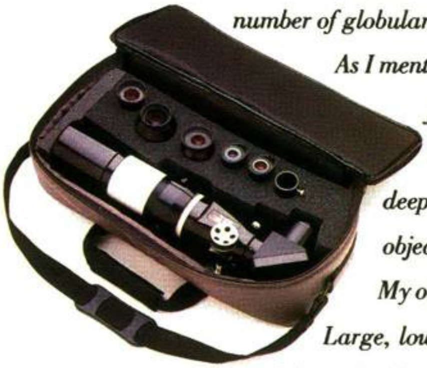
"Since I've been singing the praises of my Pronto to several people, I figure I'd better send you another note. During the November dark run, I used the Pronto on all or part of three nights. I made observations of 72 objects including a few double stars. Most of these observations were on a single night where the seeing was a little soft for the 6-inch refractor, but hardly noticeable in the Pronto. For me, the instrument's relative insensitivity to seeing is a great advantage, allowing good observing on nights I otherwise wouldn't go out.

The limiting stellar magnitude is between v=13.5 and v=14.0. This limiting magnitude is faint enough that a substantial number of globular clusters will be at least partially resolved.

As I mentioned before, the 30x eyepiece is my favorite for sweeping the Milky Way. I ended up using 50x for larger objects; 75x for 'ordinary' deep-sky viewing. A few high surface brightness objects were viewed to advantage at 110x, & I used 150x on double stars.

My observations show that from a true-dark site, the telescope is a real performer. Large, low surface brightness objects are routinely visible; even I was surprised by the visibility of NGC 147. Using the stars plotted on Uranometria, I traced the Andromeda galaxy to 4° length on two nights." – Brian Skiff, Author & Astronomer

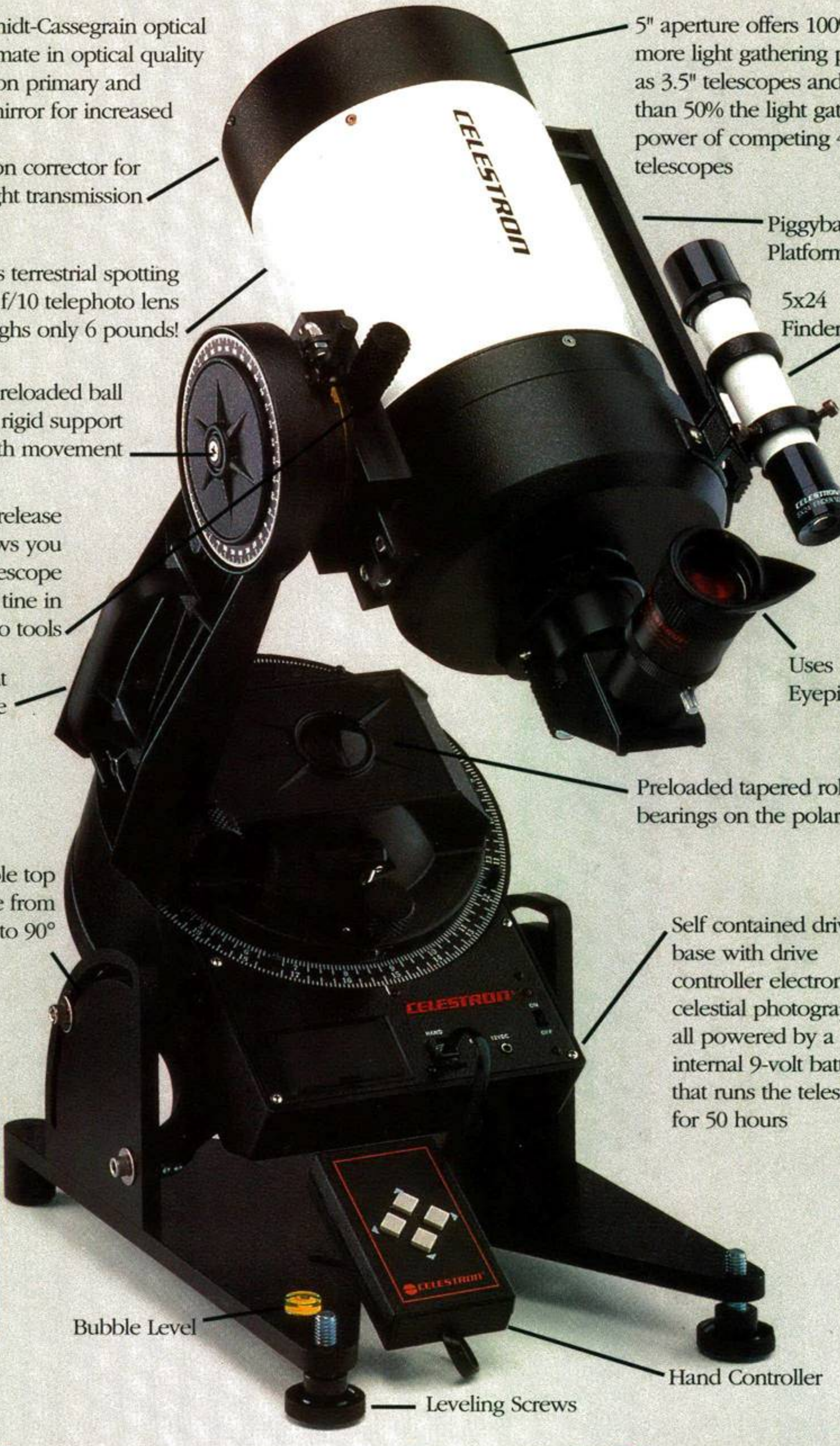
Pronto photo of Eta Carina by Ralph Sieger



Tele Vue®

Send for full-line literature, please include $3 for postage and handling
Tele Vue Optics, Dept. A, 100 Route 59, Suffern, NY 10901. (914) 357-9522

THE CELESTRON C5⁺...



Hand-figured Schmidt-Cassegrain optical system for the ultimate in optical quality
- HR coating on primary and secondary mirror for increased reflectivity
- AR coating on corrector for increased light transmission

5" aperture offers 100% more light gathering power as 3.5" telescopes and more than 50% the light gathering power of competing 4" telescopes

Piggyback Platform

5x24 Finderscope

C5 tube doubles as terrestrial spotting scope or a 1250mm f/10 telephoto lens – tube weighs only 6 pounds!

Two preloaded ball bearings for rigid support with smooth movement

Quick release mechanism allows you to remove the telescope from the fork tine in seconds with no tools

Convenient carrying handle

Uses 1-1/4" Eyepieces

Preloaded tapered roller bearings on the polar axle

Heavy-duty table top wedge adjustable from 0° to 90°

Self contained drive base with drive controller electronics for celestial photography – all powered by a single internal 9-volt battery that runs the telescope for 50 hours

Numerous accessories available for visual and photographic purposes

Compact 9"x20"x20" system allows you to take it virtually anywhere, from your backyard to a remote observing site – weighs just 23 pounds, wedge included!

Bubble Level

Hand Controller

Leveling Screws

For a brochure contact your local Celestron dealer or Celestron International directly

... Everything You Want in a Telescope

CELESTRON®

LIGHT YEARS AHEAD OF THE COMPETITION

2835 Columbia Street
Torrance, CA 90503
310/328-9560 310/212-5835 (FAX)